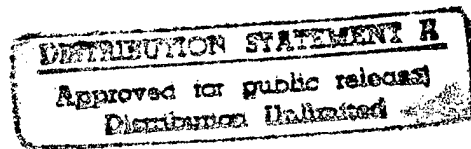


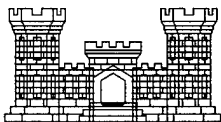
# Limited Energy Study (Glass)

## Energy Engineering Analysis Program (EEAP) Fort Knox, Kentucky

### *Final Report Volume 1 of 3*



CONTRACT #DACA01-94-D-0034  
SYSTEMS CORP PROJECT #94013.02  
OCTOBER 28, 1994



Louisville District-  
US Army Corps  
of Engineers

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**SYSTEMS***corp*

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## 1.1 SYNOPSIS

Systems Corp surveyed and completed energy analyses for 72 representative buildings at Fort Knox, categorized as gymnasium, print shop, maintenance, and warehouse facilities. The energy conservation opportunities (ECOs) evaluated were infra-red heat and window/wall insulation. Cost estimates were prepared using MeansData for Windows Spreadsheets, Version 2.0a. Life cycle cost analyses were performed using the Life Cycle Cost in Design (LCCID) computer program. Project descriptions and DD1391 forms were prepared for two Energy Conservation Investment Program (ECIP) projects. The total of the two projects that were developed represent \$538K in annual savings and a total discounted savings of \$10.1M in the twenty year life of the projects. The simple paybacks average 6.3 years and the savings to investment (SIR) for the two ECIP projects is 2.75. In addition, five FEMP projects were developed for projects totaling less than \$1,000,000 investment costs. FEMP projects one through four are infra-red heat averaging a payback of 6.1 years and an SIR of 2.8. The fifth FEMP project is window insulation for two buildings. This project is for \$17,600 of investment with a 4.74 year payback and an SIR of 4.42.

## 1.2 INTRODUCTION

Systems Engineering and Management Corporation (Systems/Corp) was contracted by the Mobile District of the United States Army Corps of Engineers in July 1994 to perform a limited energy study for 72 buildings at Fort Knox, Kentucky. The project includes a study of infra-red heat and window/wall insulation.

### 1.2.1 Scope of Work

1. Evaluate selected energy conservation opportunities (ECOs) to determine their energy savings potential and economic feasibility.
2. Conduct a limited site survey of selected buildings or areas to insure any methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.
3. Determine efficiency of existing systems. Determine the replacement option with the highest SIR.
4. Provide complete programming or implementation documentation for all recommended ECOs.
5. Prepare a comprehensive report to document the work performed, the results, and the recommendations.

## 1.2.2 Organization of the Final Report

The submitted material for this report consists of the following:

- Volume I: Executive Summary, Methods and Approach - ECIP Project 1: Infra-red Heat at 36 buildings  
ECIP Project 2: Infra-red Heat at 31 buildings
- Volume II: Scope of Work, Interim Review Comments and Responses, Interim Review Presentation and Building 2647 material  
FEMP Project 4: Infra-red Heat at 22 buildings  
FEMP Project 5: Window/wall Insulation at two buildings

## 1.3 PRESENT AND HISTORICAL ELECTRICAL ENERGY CONSUMPTION

The baseline energy consumptions and the energy conservation opportunity energy consumption were determined using spreadsheets and manual calculating to model system energy consumption. These have been included in *Section 2* of this report.

The natural gas and fuel oil consumption, and total costs for FY93 are shown in *Figure 1.3.1 Fort Knox Natural Gas and Fuel Oil*. The natural gas and fuel oil costs used to calculate the savings for the project are as follows:

Natural Gas	= \$4.62/MBtu
Fuel Oil	= \$6.60/MBtu

## 1.4 ENERGY CONSERVATION OPPORTUNITIES INVESTIGATED

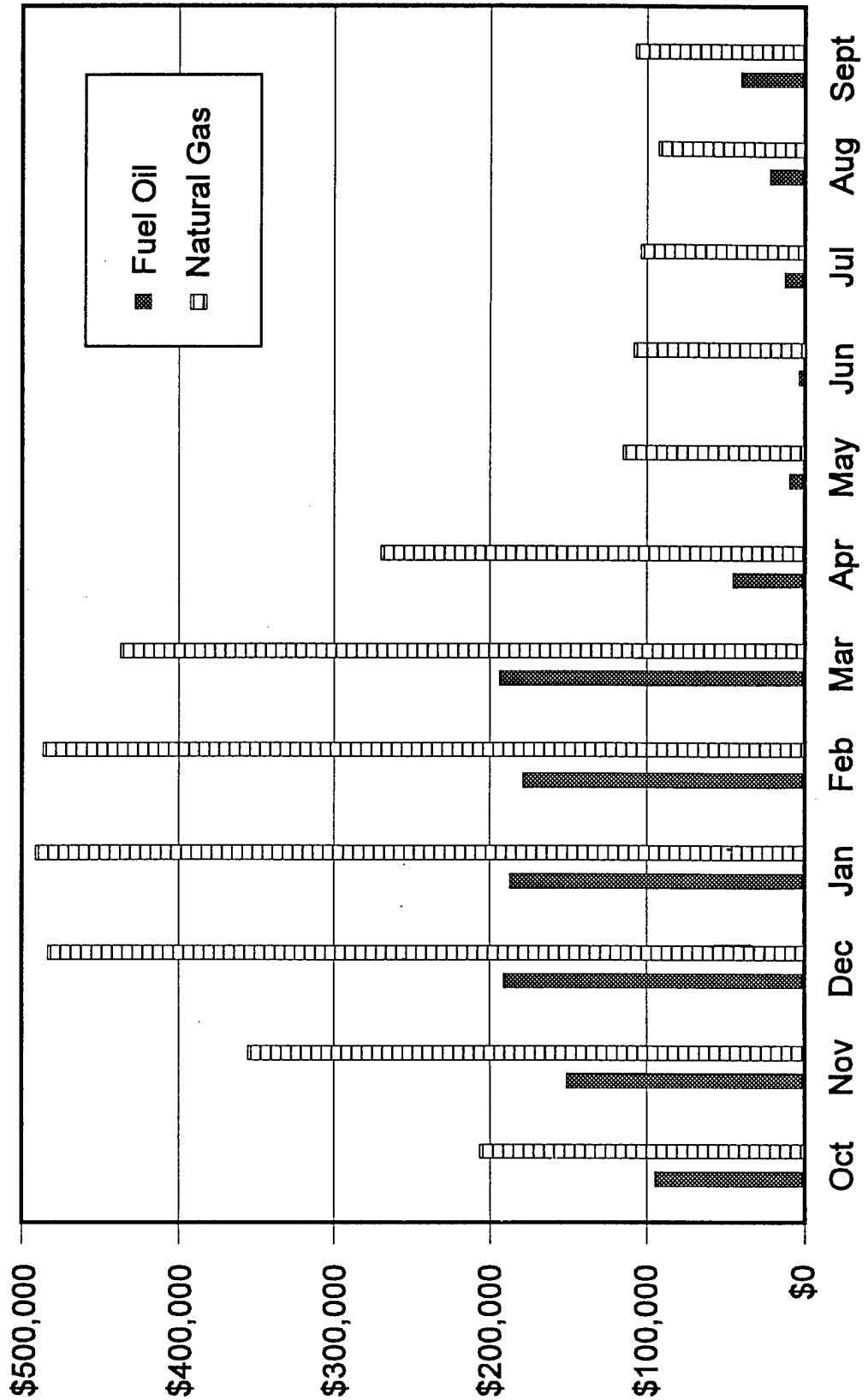
Systems Corp analyzed two energy conservation opportunities (ECOs) at Fort Knox, Kentucky. The analysis was performed utilizing energy models developed by Systems Corp and data collected during the field survey of the facilities at Fort Knox. Each ECO was evaluated to determine the potential energy savings, dollar savings, implementation costs, simple payback, life cycle cost, and savings to investment ratio (SIR). The two ECOs that were evaluated are as follows:

- ECO - 1    Infra-red Heat
- ECO - 2    Window/Wall Insulation

# FORT KNOX FY 93

## Fuel Oil and Natural Gas Consumption

Figure 1.3.1



# **1 EXECUTIVE SUMMARY**

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

Systems Corp's energy analysis models were used to determine the savings achieved for implementing each ECO in the facilities evaluated. MeansData for Windows Spreadsheets, Version 2.0a cost estimating software was used to estimate the implementation cost of each ECO in each facility evaluated. The U.S. Army Corps of Engineers' Life Cycle Cost in Design, Version 1.0, Level 80, software was used to perform life cycle cost analyses and determine the SIR of each ECO for each facility evaluated.

## **1.4.1 ECOs Recommended**

Systems Corp recommended both ECOs evaluated be implemented, but not in every area surveyed. The following is a list of the ECOs recommended to be implemented by area surveyed. The criteria for recommendation is a favorable simple payback and savings to investment ratio (SIR).

ECO - 1: Warehouse buildings  
Maintenance buildings  
Hangars

ECO - 2: Gymnasiums

## **1.4.2 ECOs Rejected**

ECO-2, Wall Insulation at the Print Shop (Bldg 2647) was rejected due to the large investment required. Due to the age of the facility, it was the decision of Ft. Knox DPW to remove the building from the project. Refer to Appendix D for The Life Cycle Cost Analysis, Cost Estimate and Calculations for this building.

## **1.4.3 ECIP and FEMP Projects Developed**

Systems Corp developed two ECIP projects and five FEMP projects. The two ECIP projects include infra-red heat at 67 buildings. Some of the FEMP projects include the same buildings in the ECIP projects. This will allow Fort Knox the flexibility to pursue either type of funding. FEMP projects 1 & 2 include the same buildings as ECIP Project 1 except the FEMP projects were broken into two smaller projects with each project requiring less than \$1,000,000 investment. FEMP Projects 3 and 4 are similar to ECIP Project 2, except FEMP Project 4 includes buildings 5220 and 5253. FEMP Project 5 includes the two buildings evaluated for window insulation. The following table, Table 1.4.3, summarizes the savings and investments for each project.

**TABLE 1.4.3**  
**FORT KNOX ENERGY STUDY:**  
**PROJECT SUMMARY**

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1ST YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
1	86	\$49,565	\$9,887	5.01	4.13	10.67%
1	92, 94, 98, 100 & 101	\$292,227	\$62,199	3.66	4.30	10.89%
1	482	\$74,902	\$12,479	6.00	2.65	8.25%
1	483	\$74,902	\$12,550	5.97	2.66	8.28%
1	484	\$74,902	\$7,027	10.66	1.85	6.33%
1	485	\$74,902	\$12,461	6.01	2.65	8.24%
1	486A, 486B & 486HB	\$158,261	\$25,713	6.16	2.59	8.12%
1	FEMP PROJECT 1	\$803,262	\$159,912	5.02	3.24	9.34%
1	2754 & 2755	\$66,417	\$10,419	6.37	2.49	7.91%
1	2756 & 2757	\$66,417	\$10,414	6.38	2.49	7.19%
1	2786 - 2789	\$121,125	\$10,387	11.66	1.65	5.71%
1	2955, 2959 & 2960	\$111,176	\$10,643	10.45	1.87	6.37%
1	2961, 2963 & 2964	\$117,512	\$16,755	7.01	2.23	7.23%
1	2969 & 2972	\$78,484	\$11,910	6.59	2.40	7.72%
1	2970 & 2971	\$78,484	\$11,896	6.60	2.40	7.71%
1	2958, 2973, 2974, 2979 & 2980	\$241,454	\$22,401	10.78	1.82	6.22%
1	FEMP PROJECT 2	\$881,069	\$104,825	8.41	2.06	6.90%
1	ECIP PROJECT 1 INCL. FEMP 1 & 2	\$1,684,331	\$264,736	6.36	2.62	8.20%
1	2762 - 2767, 2778 & 2781	\$483,650	\$48,583	9.96	2.03	6.82%
1	2770	\$271,299	\$73,478	3.69	5.57	12.34%
1	2942 - 2944	\$226,146	\$44,565	5.07	3.12	9.14%
1	FEMP PROJECT 3	\$981,094	\$166,626	5389.00	3.26	9.38%
1	5220	\$78,231	\$25,402	3.12	5.05	11.79%
1	5253	\$45,837	\$15,647	2.93	5.38	12.15%
1	6113-6118,6142-6147	\$503,778	\$77,721	6.48	2.44	7.80%
1	6560-6564,6576,6577	\$263,339	\$36,858	7.14	2.22	7.29%
1	6592	\$37,462	\$4,810	7.79	2.41	7.73%
1	FEMP PROJECT 4	\$928,646	\$160,076	5.80	2.74	8.43%
1	ECIP PROJECT 2 INCL FEMP 3 & 4 EXCEPT 5220 & 5253	\$1,785,673	\$286,015	6.24	2.86	8.66%

**TABLE 1.4.3**  
**FORT KNOX ENERGY STUDY:**  
**PROJECT SUMMARY**

ECO NUMBER	BUILDING NUMBER	TOTAL INVESTMENT	1ST YEAR SAVINGS	SIMPLE PAYBACK	SIR	AIRR
2	5297	\$8,973	\$1,855	4.74	4.42	11.05%
2	6591	\$8,973	\$1,855	4.74	4.42	11.05%
2	FEMP PROJECT 5	\$17,946	\$3,710	4.74	4.42	11.05%

## 2 METHODS AND APPROACH

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

### 2.1 FIELD SURVEY

The field survey as performed by Systems Corp was designed to provide the necessary data required to complete the Scope of Work for this project. It was also designed to provide residual benefits to the installation by providing an organized and readily available source of information which can be used in future years. The information was transmitted in the form of field notes using standardized survey forms.

The survey forms were designed to allow notations of all data which could be utilized (not necessarily required) to calculate the energy savings gained by implementing a specific energy conservation opportunity. These forms contain data obtained from as-built drawings and confirmed in the field, as well as data obtained only in the field. *Table 2.1.1* lists the buildings surveyed, sorted by type.

Thorough preparation for the building survey ensures the data required to perform the technical analysis is obtained. The building surveys were performed in a manner which assured the best results. A simple listing of each step of the process best describes our approach to the surveys.

1. The list of ECOs included in the work scope were reviewed in detail.
2. Each ECO was given an identification number which is used consistently throughout this project.
3. An expanded description of each ECO was formulated to outline the possible methods for implementation of the ECO.
4. Survey forms were developed for each ECO to provide space to enter any data which might possibly be used in performing the engineering and economic analysis of the ECO.
5. A list of the types of as-built drawings required for the buildings was prepared based on the information required on the ECO survey forms.
6. The building surveys are then performed, confirming or revising data obtained from the drawing and old energy studies. Additional data is obtained as required.

*Note: A Systems Corp representative assisted during the survey in gathering the necessary as-built drawings. Due to the age of drawings, most of the required information was gathered during the survey, while physically present at the buildings.*

7. The Systems Corp survey team met with the post Energy Officer throughout the survey on an as-needed basis.

### 2.2 CALCULATIONS

Energy calculations were performed using computerized techniques. Due to the large volume of calculations to be performed, standardized procedures were developed for the computer models. This assured consistent results and uniformity of quality in all of the calculations performed.



**TABLE 2.1.1**  
**BUILDINGS SURVEYED**

<b>BUILDING TYPE</b>	<b>BUILDING NUMBER</b>	<b>BUILDING AREA</b>
<b>GYMNASIUMS</b>	5927	21,679
	6591	21,679
	<b>TOTAL AREA THIS TYPE</b>	<b>43,358</b>
<b>PRINT SHOP</b>	2647	24,480
	<b>TOTAL AREA THIS TYPE</b>	<b>24,480</b>
<b>WAREHOUSE/STORAGE</b>	86	14,278
	92	12,420
	2781	29,952
	<b>TOTAL AREA THIS TYPE</b>	<b>56,650</b>
<b>AIRCRAFT HANGAR</b>	5220	30,873
	5253	14,976
	<b>TOTAL AREA THIS TYPE</b>	<b>45,849</b>
<b>GENERAL MAINTENANCE SHOPS</b>	94	30,894
	98	8,528
	100	3,600
	101	5,460
	<b>TOTAL AREA THIS TYPE</b>	<b>48,482</b>

**TABLE 2.1.1**  
**BUILDINGS SURVEYED**

<b>BUILDING TYPE</b>	<b>BUILDING NUMBER</b>	<b>BUILDING AREA</b>
VEHICLE MAINTENANCE SHOP	482	15,525
	483	15,525
	484	15,525
	485	15,525
	486A	15,525
	486B & 486HB	17,685
	2770	112,500
	2778	49,500
	2942	17,220
	2943	17,220
	<b>TOTAL AREA THIS TYPE</b>	<b>291,750</b>
TANK MAINTENANCE SHOP	2754	5,000
	2755	5,000
	2756	5,000
	2757	5,000
	2762	4,800
	2763	4,800
	2764	4,800
	2765	4,800
	2766	4,800
	2767	4,800
	2786	4800
	2787	4800
	2788	4800
	2789	4800
	2944	21,497
	2955	6,900
	2958	20,270
	2959	6,900
	2960	6,900
	2961	6,900
	2963	6,900

**TABLE 2.1.1**  
**BUILDINGS SURVEYED**

<b>BUILDING TYPE</b>	<b>BUILDING NUMBER</b>	<b>BUILDING AREA</b>
<b>TANK MAINTENANCE SHOP, CON'T.</b>		
	2964	6,900
	2969	6,900
	2970	6,900
	2971	6,900
	2972	6,900
	2973	6,900
	2974	6,900
	2979	6,900
	2980	6,900
	6113	6,900
	6114	6,900
	6115	6,900
	6116	6,900
	6117	6,900
	6118	6,900
	6142	8,100
	6143	8,100
	6144	8,100
	6145	8,100
	6146	8,100
	6147	8,100
	6560	4,800
	6561	4,800
	6562	4,800
	6563	4,800
	6564	4,800
	6576	6,900
	6577	6,900
	6592	8,100
	<b>TOTAL AREA THIS TYPE</b>	<b>342,267</b>
<b>TOTAL AREA SURVEYED</b>		<b>852,836</b>

## **2 METHODS AND APPROACH**

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

### **2.2.1 Baseline Energy Consumption**

The following sections will describe the method for calculating the baseline energy consumption for each of the two ECOs.

#### **2.2.1.1 Baseline Energy Consumption: ECO-1 (Infra-red Heat)**

The baseline energy consumption for this ECO was calculated using a LOTUS123 spreadsheet. This spreadsheet modeled the energy consumption of the existing heating systems by utilizing the following:

1. Building material
2. Building dimensions
3. Thermostat setpoints
4. Weather bin data
5. Heat system efficiencies
6. Fuel sources

The above information was obtained during the field survey. *Table 2.2.1.1.1* lists the baseline energy consumption for the buildings surveyed for ECO-1.

#### **2.2.1.2 Baseline Energy Consumption: ECO-2 (Window/Wall Insulation)**

The baseline energy consumption for this ECO was also calculated using a LOTUS123 spreadsheet. This spread sheet modeled the energy consumption of the existing window/wall systems by utilizing the following:

1. Building material
2. Building dimensions
3. Thermostat setpoints
4. Weather bin data
5. Heating system efficiencies
6. Fuel sources

The above information was obtained during the field survey. *Table 2.2.1.2.1* lists the baseline energy consumption for the buildings included in ECO-2.

**TABLE 2.2.1.1.1**  
**BASELINE ENERGY**  
**CONSUMPTION FOR ECO-1**

ECO NUMBER	BUILDING NUMBER	BASELINE ENERGY CONSUMPTION (MJ)
1	86	4,234,411.30
1	92	2,445,004.70
1	94	10,042,270.70
1	98	3,014,651.95
1	100	756,825.35
1	101	2,141,417.90
1	482	2,509,370.25
1	483	2,515,953.45
1	484	2,540,830.35
1	485	2,505,002.55
1	486A	2,470,493.50
1	486B & 486HB	2,848,732.10
1	2754	961,052.25
1	2755	961,052.25
1	2756	961,052.25
1	2757	961,052.25
1	2762	995,730.10
1	2763	995,730.10
1	2764	995,730.10
1	2765	995,730.10
1	2766	995,730.10
1	2767	995,730.10
1	2770	30,741,455.10
1	2778	9,263,459.15
1	2781	3,909,154.80
1	2786	837,944.30
1	2787	837,944.30
1	2788	837,944.30
1	2789	837,944.30
1	2942	2,525,353.50

**TABLE 2.2.1.1.1**  
**BASELINE ENERGY**  
**CONSUMPTION FOR ECO-1**

<b>ECO NUMBER</b>	<b>BUILDING NUMBER</b>	<b>BASELINE ENERGY CONSUMPTION (MJ)</b>
1	2943	2,525,353.50
1	2944	3,962,696.05
1	2955	1,215,106.80
1	2958	3,416,047.80
1	2959	1,215,106.80
1	2960	1,215,106.80
1	2961	1,215,106.80
1	2963	1,093,676.30
1	2964	1,215,106.80
1	2969	1,093,676.30
1	2970	1,093,676.30
1	2971	1,093,676.30
1	2972	1,093,676.30
1	2973	1,093,676.30
1	2974	1,093,676.30
1	2979	1,093,676.30
1	2980	1,093,676.30
1	5220	5,998,814.40
1	5253	3,721,670.75
1	6113	1,215,106.80
1	6114	1,215,106.80
1	6115	1,215,106.80
1	6116	1,215,106.80
1	6117	1,215,106.80
1	6118	1,215,106.80
1	6142	1,389,245.10
1	6143	1,389,245.10
1	6144	1,389,245.10
1	6145	1,389,245.10
1	6146	1,389,245.10

# **TABLE 2.2.1.1.1** **BASELINE ENERGY** **CONSUMPTION FOR ECO-1**

<b>ECO NUMBER</b>	<b>BUILDING NUMBER</b>	<b>BASELINE ENERGY CONSUMPTION (MJ)</b>
1	6147	1,389,245.10
1	6560	936,312.50
1	6561	936,312.50
1	6562	936,312.50
1	6563	936,312.50
1	6564	936,312.50
1	6576	1,124,524.50
1	6577	1,124,524.50
1	6592	1,389,245.10

**TABLE 2.2.1.2.1**  
**BASELINE ENERGY**  
**CONSUMPTION FOR ECO-2**

ECO NUMBER	BUILDING NUMBER	BASELINE ENERGY CONSUMPTION (MJ)
2	2647	7,312,342.15
2	5927	2,762,401.45
2	6591	2,795,908.25



## **2 METHODS AND APPROACH**

*FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY*

### **2.2.2 ECO Energy Consumption**

The following sections describe how the energy consumption (or energy savings) for each of the two ECOs was calculated.

#### **2.2.2.1. ECO Energy Consumption: ECO-1 (Infra-red Heat)**

The energy consumption for this ECO was calculated in the same manner as the baseline for ECO-1. New heating system efficiencies, fuel source, and thermostat settings were substituted for the existing heating system configurations. Many of the buildings currently use fuel oil as a fuel source. For the replacement heating systems, natural gas was used as a fuel source. This included adding to the current natural gas distribution system as needed. The energy consumption for this ECO was calculated using a thermostat setpoint of 55°F.

#### **2.2.2.2 ECO Energy Consumption: ECO-2 (Window/Wall Insulation)**

The energy consumption for this ECO was calculated in the same manner as the baseline for ECO-2. Additional insulating values were added to the existing window or wall systems.

### **2.3 ENERGY CONSERVATION OPPORTUNITIES**

The energy consumption for each of the energy conservation opportunities was prepared after the successful run of the baseline calculations. Calculation of the ECOs requires preparing a conceptual design which would allow implementation of the ECO. It is important to note an ECO may be implemented in several ways. The designer must carefully consider the options to ensure the chosen design is the most likely to result in a savings that can justify the investment. After completing the conceptual design, the energy results were calculated by computer spreadsheets. The calculations were then reviewed for accuracy and technical feasibility. When problems were discovered, the calculations were revised and corrected.

After completing the energy calculations for each ECO, the cost estimates and economic analysis were prepared. A standardized bill of materials was prepared for each building within each ECO. Material sizes, quantities, and prices were prepared to represent specific conditions of the ECO. Annual and non-annual recurring costs are an important part of the life cycle cost for a given project. Each ECO was evaluated individually to determine the correct difference in these costs between the current condition and the future condition.

## 2 METHODS AND APPROACH

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

The following is a description for each ECO of how the calculations were performed in terms of the energy-efficient replacement products used.

### 2.3.1 ECO-1: Infra-red Heat

Two types of infra-red heaters were evaluated under this ECO: high intensity and low intensity. Once the appropriate type of infra-red heat was determined for each application, energy and dollar savings were calculated for each building. To calculate the savings, the efficiency of the infra-red heating system (90%) was substituted for the current heating system efficiency. In addition, natural gas was the only fuel source used for the infra-red heating system. If natural gas is not currently available to the facility, the cost estimate included the cost of expanding the natural gas service to that facility and area. Lastly, a 55°F air temperature was assumed for the infra-red heating systems. Because infra-red heat is a more effective heat source, the space temperature can be reduced while maintaining a comfortable work environment.

### 2.3.2 ECO-2: Window/Wall Insulation

Many options were available which would fulfill this ECO. The goal was to increase the insulating value of the window and/or wall insulation areas as much as possible while still being cost effective and maintain the current benefits of daylighting, where appropriate.

The following is a description of the options implemented.

- The clear acrylic sheet is installed over the existing single pane glass window with a magnetic seal strip. The acrylic sheet will reduce the infiltration and heat loss by 90% while maintaining the current benefit of daylighting.
- Dryvit is an exterior insulation material. The Dryvit is installed over the existing exterior walls and windows on the saw-tooth roof.

## 2.4 ECO LIFE CYCLE COSTS

The life cycle cost analyses for the ECOs are a combination of energy costs, investment costs, maintenance costs, and replacement costs. Each of these components may, or may not, be significant factors in determining the life cycle cost of the project. Each of these cost components has been evaluated for each ECO calculated in order to determine the contribution, if any, to the life cycle cost of the project.

The life cycle costs were calculated using the computer program Life Cycle Costing in Design (LCCID) as required in the Scope of Work.

## 2 METHODS AND APPROACH

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

### 2.4.1 Energy Costs - Fuel Oil and Natural Gas

Energy costs for each type of fuel used in the buildings included in the Scope of Work were obtained from the installation. The costs were obtained along with the amount of energy used for FY93. Average energy costs per unit of natural gas and fuel oil were determined by Fort Knox and supplied to Systems Corp.

Natural Gas	= \$4.62/MBtu
Fuel Oil	= \$6.60/MBtu

### 2.4.2 Maintenance and Replacement Costs

The maintenance and operating cost/savings for each ECO were calculated, where applicable. First considered was whether or not the annual recurring (maintenance and operation) non-energy costs would significantly change as a result of each ECO. These values are sometimes unjustifiably manipulated to produce the desired results for the project economic analysis. Therefore, it was typically assumed maintenance and operation activities will continue at the same rate as before the project. However, readily identifiable differences, such as boiler maintenance, have been included. The estimated costs were obtained from the Means Facilities Maintenance and Repair Costs Data, 1994, and the Fort Knox Environmental Department. These costs are shown on each life cycle cost summary sheet included in Sections 3 through 5 of this report.

The replacement costs (non-energy non-annual recurring costs) for each ECO have been evaluated in the same manner as non-energy annual recurring costs. Some examples of these types of cost items are as follows:

- fuel oil tank replacement
- boiler repair
- steamtrap replacement
- unit heater repair

It is the policy of Systems Corp to be conservative when estimating these more subjective cost components--which, if improperly evaluated, could result in inappropriate project qualification and funding decisions.

Table 2.4.2.1 shows the maintenance and replacement costs used in our analysis for the buildings included in ECO-1.

**TABLE 2.4.2.1**  
**MAINTENANCE AND REPLACEMENT**  
**COSTS FOR ECO-1**

DESCRIPTION OF WORK	MATERIAL COST	LABOR COST	TOTAL IN- HOUSE COST
PREVENTIVE MAINTENANCE ON HOT WATER BOILER, OVER 1 MBTH, PERFORMED ANNUALLY	\$90.00	\$700.00	\$790.00
PREVENTIVE MAINTENANCE ON STEAM BOILER, OVER 1 MBTH, PERFORMED ANNUALLY	\$170.00	\$820.00	\$990.00
PREVENTIVE MAINTENANCE ON UNIT HEATERS, PERFORMED ANNUALLY	\$120.00	\$275.00	\$395.00
REPAIR OF NATURAL GAS BOILER , BETWEEN 1MBTH AND 10 MBTH, PERFORMED EVERY 7 YRS	\$2,295.50	\$915.85	\$3,211.35
REPAIR OF FUEL OIL BOILER , BETWEEN 1MBTH AND 10 MBTH, PERFORMED EVERY 7 YRS	\$477.70	\$431.40	\$909.10
REPAIR OF UNIT HEATERS, PERFORMED EVERY 10 YRS	\$150.00	\$124.15	\$274.15
REPLACE STEAM TRAP, 1" THREADED, PERFORMED EVERY 10 YRS	\$120.00	\$49.40	\$169.40

## 2 METHODS AND APPROACH

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

*Table 2.4.2.2* is a listing of the recurring, non-energy costs calculated for ECO-1. The only recurring costs included in this analysis is the preventive maintenance performed on the existing boilers. These costs were then used in the life cycle cost analysis for the annual recurring, non-energy savings.

*Table 2.4.2.3* through *2.4.2.6* is a listing of the non-recurring, non-energy costs calculated for ECO-1. Boiler repair, unit heater repair, steam trap replacement and fuel tank replacement were calculated for each unit heater, boiler, or fuel tank that will be removed with the installation of the infra-red heating system. It was assumed there is one steam trap for each unit heater. It is assumed each non-recurring, non-energy cost activity will occur twice during the twenty-year life of the system except the fuel tank replacement. The fuel oil tank replacement was scheduled for 1998 by the Fort Knox Environmental Department. This replacement will not be necessary when natural gas is supplied to the buildings for the heating system needs.

Boiler repair is estimated to occur every seven years. This was scheduled to occur at year seven and fourteen for the cost analysis. The unit heater repair and steam trap replacement occurs every ten years; year five and year fifteen of the cost analysis. *Table 2.4.2.7* is a listing of the total non-recurring, non-energy cost savings for each building or area. This total cost will occur for every occurrence, i.e. every seven or ten years.

**TABLE 2.4.2.2**  
**RECURRING, NON-ENERGY**  
**BOILER PREVENTIVE**  
**MAINTENANCE**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	NO. OF BOILERS	PREVENTIVE MAINTENANCE PER BOILER	TOTAL BOILER MAINTENANCE COST
86	N/A	N/A	\$0.00
92, 94 & 101	2	\$790.00	\$1,580.00
98 & 100	1	\$790.00	\$790.00
482	1	\$790.00	\$790.00
483	1	\$790.00	\$790.00
484	1	\$790.00	\$790.00
485	1	\$790.00	\$790.00
86A, 486B & 486H	1	\$790.00	\$790.00
2754 & 2755	1	\$990.00	\$990.00
2756 & 2757	1	\$990.00	\$990.00
2762-2767, 2778 & 2781	2	\$990.00	\$1,980.00
2770	2	\$990.00	\$1,980.00
2786 - 2789	1	\$990.00	\$990.00
2955, 2959 & 2960	1	\$990.00	\$990.00
2961, 2963 & 2964	1	\$990.00	\$990.00
2969 & 2972	1	\$990.00	\$990.00
2970 & 2971	1	\$990.00	\$990.00
2958, 2973, 2974, 2979 & 2980	2	\$990.00	\$1,980.00
2942	1	\$990.00	\$990.00
2943	1	\$990.00	\$990.00
2944	1	\$990.00	\$990.00
5220	N/A	N/A	\$0.00
5253	N/A	N/A	\$0.00
6113, 6114 & 6115	1	\$990.00	\$990.00
6116, 6117 & 6118	1	\$990.00	\$990.00
6142, 6143 & 6144	1	\$990.00	\$990.00
6145, 6146 & 6147	1	\$990.00	\$990.00
6560, 6561 & 6562	1	\$990.00	\$990.00
6563 & 6564	1	\$990.00	\$990.00
6576 & 6577	1	\$990.00	\$990.00
6592	1	\$990.00	\$990.00

**TABLE 2.4.2.3**  
**NON-RECURRING, NON-ENERGY**  
**BOILER REPAIR**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	NO. OF BOILERS	REPAIR COST PER BOILER	TOTAL BOILER REPAIR COST
86	N/A	N/A	\$0.00
92, 94 & 101	2	\$909.10	\$1,818.20
98 & 100	1	\$909.10	\$909.10
482	1	\$909.10	\$909.10
483	1	\$909.10	\$909.10
484	1	\$3,211.35	\$3,211.35
485	1	\$909.10	\$909.10
86A, 486B & 486H	1	\$909.10	\$909.10
2754 & 2755	1	\$909.10	\$909.10
2756 & 2757	1	\$909.10	\$909.10
2762-2767, 2778 & 2781	2	\$3,211.35	\$6,422.70
2770	2	\$3,211.35	\$6,422.70
2786 - 2789	1	\$3,211.35	\$3,211.35
2955, 2959 & 2960	1	\$3,211.35	\$3,211.35
2961, 2963 & 2964	1	\$909.10	\$909.10
2969 & 2972	1	\$909.10	\$909.10
2970 & 2971	1	\$909.10	\$909.10
2958, 2973, 2974, 2979 & 2980	2	\$3,211.35	\$6,422.70
2942	1	\$909.10	\$909.10
2943	1	\$909.10	\$909.10
2944	1	\$909.10	\$909.10
5220	N/A	N/A	\$0.00
5253	N/A	N/A	\$0.00
6113, 6114 & 6115	1	\$909.10	\$909.10
6116, 6117 & 6118	1	\$909.10	\$909.10
6142, 6143 & 6144	1	\$909.10	\$909.10
6145, 6146 & 6147	1	\$909.10	\$909.10
6560, 6561 & 6562	1	\$909.10	\$909.10
6563 & 6564	1	\$909.10	\$909.10
6576 & 6577	1	\$909.10	\$909.10
6592	1	\$3,211.35	\$3,211.35

**TABLE 2.4.2.4**  
**NON-RECURRING, NON-ENERGY**  
**UNIT HEATER REPAIR**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	NO. OF HEATERS PER BLDG	REPAIR COST PER HEATER	TOTAL HEATER REPAIR COST PER BLDG
86	16	\$274.15	\$4,386.40
92	14	\$274.15	\$3,838.10
94	24	\$274.15	\$6,579.60
101	2	\$274.15	\$548.30
98	14	\$274.15	\$3,838.10
100	3	\$274.15	\$822.45
482	8	\$274.15	\$2,193.20
483	9	\$274.15	\$2,467.35
484	9	\$274.15	\$2,467.35
485	8	\$274.15	\$2,193.20
486A	11	\$274.15	\$3,015.65
486B	14	\$274.15	\$3,838.10
486HB	4	\$274.15	\$1,096.60
2754 & 2755	5	\$274.15	\$1,370.75
2756 & 2757	5	\$274.15	\$1,370.75
2762	4	\$274.15	\$1,096.60
2763	6	\$274.15	\$1,644.90
2764	5	\$274.15	\$1,370.75
2765	5	\$274.15	\$1,370.75
276	6	\$274.15	\$1,644.90
2767	5	\$274.15	\$1,370.75
2778	27	\$274.15	\$7,402.05
2781	15	\$274.15	\$4,112.25
2770	51	\$274.15	\$13,981.65
2786 - 2789	9	\$274.15	\$2,467.35
2955, 2959 & 2960	9	\$274.15	\$2,467.35
2961, 2963 & 2964	9	\$274.15	\$2,467.35
2969 & 2972	9	\$274.15	\$2,467.35
2970 & 2971	9	\$274.15	\$2,467.35



**TABLE 2.4.2.4**  
**NON-RECURRING, NON-ENERGY**  
**UNIT HEATER REPAIR**  
**COST SAVINGS FOR ECO-1**

<b>BUILDING #'S &amp; GROUPINGS</b>	<b>NO. OF HEATERS PER BLDG</b>	<b>REPAIR COST PER HEATER</b>	<b>TOTAL HEATER REPAIR COST PER BLDG</b>
2958	18	\$274.15	\$4,934.70
2973	9	\$274.15	\$2,467.35
2974	9	\$274.15	\$2,467.35
2979	9	\$274.15	\$2,467.35
2980	9	\$274.15	\$2,467.35
2942	6	\$274.15	\$1,644.90
2943	6	\$274.15	\$1,644.90
2944	13	\$274.15	\$3,563.95
5220	9	\$274.15	\$2,467.35
5253	8	\$274.15	\$2,193.20
6113, 6114 & 6115	9	\$274.15	\$2,467.35
6116, 6117 & 6118	9	\$274.15	\$2,467.35
6142, 6143 & 6144	9	\$274.15	\$2,467.35
6145, 6146 & 6147	9	\$274.15	\$2,467.35
6560, 6561 & 6562	5	\$274.15	\$1,370.75
6563 & 6564	5	\$274.15	\$1,370.75
6576 & 6577	9	\$274.15	\$2,467.35
6592	9	\$274.15	\$2,467.35

**TABLE 2.4.2.5**  
**NON-RECURRING, NON-ENERGY**  
**STEAM TRAP REPLACEMENT**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	NO. OF STEAM TRAPS/BLDG	REPAIR COST PER STEAM TRAP	TOTAL TRAP REPLACEMENT COST / BLDG
86	0	\$169.40	\$0.00
92	0	\$169.40	\$0.00
94	0	\$169.40	\$0.00
101	0	\$169.40	\$0.00
98	0	\$169.40	\$0.00
100	0	\$169.40	\$0.00
482	0	\$169.40	\$0.00
483	0	\$169.40	\$0.00
484	0	\$169.40	\$0.00
485	0	\$169.40	\$0.00
486A	0	\$169.40	\$0.00
486B	0	\$169.40	\$0.00
486HB	0	\$169.40	\$0.00
2754 & 2755	5	\$169.40	\$847.00
2756 & 2757	5	\$169.40	\$847.00
2762	4	\$169.40	\$677.60
2763	6	\$169.40	\$1,016.40
2764	5	\$169.40	\$847.00
2765	5	\$169.40	\$847.00
276	6	\$169.40	\$1,016.40
2767	5	\$169.40	\$847.00
2778	27	\$169.40	\$4,573.80
2781	15	\$169.40	\$2,541.00
2770	51	\$169.40	\$8,639.40
2786 - 2789	9	\$169.40	\$1,524.60
2955, 2959 & 2960	9	\$169.40	\$1,524.60
2961, 2963 & 2964	9	\$169.40	\$1,524.60
2969 & 2972	9	\$169.40	\$1,524.60
2970 & 2971	9	\$169.40	\$1,524.60

**TABLE 2.4.2.5**  
**NON-RECURRING, NON-ENERGY**  
**STEAM TRAP REPLACEMENT**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	NO. OF STEAM TRAPS/BLDG	REPAIR COST PER STEAM TRAP	TOTAL TRAP REPLACEMENT COST / BLDG
2958	18	\$169.40	\$3,049.20
2973	9	\$169.40	\$1,524.60
2974	9	\$169.40	\$1,524.60
2979	9	\$169.40	\$1,524.60
2980	9	\$169.40	\$1,524.60
2942	6	\$169.40	\$1,016.40
2943	6	\$169.40	\$1,016.40
2944	13	\$169.40	\$2,202.20
5220	9	\$169.40	\$1,524.60
5253	8	\$169.40	\$1,355.20
6113, 6114 & 6115	9	\$169.40	\$1,524.60
6116, 6117 & 6118	9	\$169.40	\$1,524.60
6142, 6143 & 6144	9	\$169.40	\$1,524.60
6145, 6146 & 6147	9	\$169.40	\$1,524.60
6560, 6561 & 6562	5	\$169.40	\$847.00
6563 & 6564	5	\$169.40	\$847.00
6576 & 6577	9	\$169.40	\$1,524.60
6592	9	\$169.40	\$1,524.60

**TABLE 2.4.2.6**  
**NON-RECURRING, NON-ENERGY**  
**FUEL TANK**  
**REPLACEMENT**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	BUILDING # WITH FUEL TANK	FUEL TANK REPLACEMENT COST
86	N/A	\$0.00
92, 94 & 101	N/A	\$0.00
98 & 100	N/A	\$0.00
482	482	\$21,400.00
483	483	\$21,730.00
484	N/A	\$0.00
485	1	\$21,400.00
486A, 486B & 486HB	486A & B	\$43,514.00
2754 & 2755	2755	\$19,958.00
2756 & 2757	2757	\$19,870.00
2762-2767, 2778 &		
2781	N/A	\$0.00
2770	N/A	\$0.00
2786 - 2789	N/A	\$0.00
2955, 2959 & 2960	N/A	\$0.00
2961, 2963 & 2964	2963	\$0.00
2969 & 2972	2969	\$20,896.00
2970 & 2971	2970	\$20,621.00
2958, 2973, 2974,	2958	
2979 & 2980	N/A	\$0.00
2942	2942	\$21,319.00
2943	2943	\$21,444.00
2944	2944	\$20,940.00
5220	N/A	\$0.00
5253	N/A	\$0.00
6113, 6114 & 6115	6114	\$21,434.00
6116, 6117 & 6118	6117	\$21,434.00
6142, 6143 & 6144	6143	\$22,687.00
6145, 6146 & 6147	6146	\$22,706.00
6560, 6561 & 6562	6561	\$21,834.00
6563 & 6564	6564	\$20,163.00
6576 & 6577	6577	\$22,741.00
6592	N/A	\$0.00

**TABLE 2.4.2.7**  
**TOTAL NON-RECURRING, NON-ENERGY**  
**COST SAVINGS FOR ECO-1**

BUILDING #'S & GROUPINGS	BOILER REPAIR COSTS	HEATER REPAIR COSTS	STEAM TRAP REPLACEMENT COSTS	FUEL TANK REPLACEMENT COSTS	TOTAL NON-RECURRING NON-ENERGY COST SAVINGS
86	\$0.00	\$4,386.40	\$0.00	\$0.00	\$4,386.40
92, 94 & 101	\$1,818.20	\$10,966.00	\$0.00	\$0.00	\$12,784.20
98 & 100	\$909.10	\$4,660.55	\$0.00	\$0.00	\$5,569.65
482	\$909.10	\$2,193.20	\$0.00	\$21,400.00	\$3,102.30
483	\$909.10	\$2,467.35	\$0.00	\$21,730.00	\$3,376.45
484	\$3,211.35	\$2,467.35	\$0.00	\$0.00	\$5,678.70
485	\$909.10	\$2,193.20	\$0.00	\$21,400.00	\$3,102.30
86A, 486B & 486H	\$909.10	\$8,040.35	\$0.00	\$43,514.00	\$8,949.45
2754 & 2755	\$909.10	\$2,741.50	\$1,694.00	\$19,958.00	\$5,344.60
2756 & 2757	\$909.10	\$2,741.50	\$1,694.00	\$19,870.00	\$5,344.60
2762-2767, 2778 & 2781	\$6,422.70	\$20,012.95	\$12,366.20	\$0.00	\$38,801.85
2770	\$6,422.70	\$13,981.65	\$8,639.40	\$0.00	\$29,043.75
2786 - 2789	\$3,211.35	\$9,869.40	\$6,098.40	\$0.00	\$19,179.15
2955, 2959 & 2960	\$3,211.35	\$7,402.05	\$4,573.80	\$0.00	\$15,187.20
2961, 2963 & 2964	\$909.10	\$7,402.05	\$4,573.80	\$0.00	\$12,884.95
2969 & 2972	\$909.10	\$4,934.70	\$3,049.20	\$20,896.00	\$8,893.00
2970 & 2971	\$909.10	\$4,934.70	\$3,049.20	\$20,621.00	\$8,893.00
2958, 2973, 2974, 2979 & 2980	\$6,422.70	\$14,804.10	\$9,147.60	\$0.00	\$30,374.40
2942	\$909.10	\$1,644.90	\$1,016.40	\$21,319.00	\$3,570.40
2943	\$909.10	\$1,644.90	\$1,016.40	\$21,444.00	\$3,570.40
2944	\$909.10	\$3,563.95	\$2,202.20	\$20,940.00	\$6,675.25
5220	\$0.00	\$2,467.35	\$1,524.60	\$0.00	\$3,991.95
5253	\$0.00	\$2,193.20	\$1,355.20	\$0.00	\$3,548.40
6113, 6114 & 6115	\$909.10	\$7,402.05	\$4,573.80	\$21,434.00	\$12,884.95
6116, 6117 & 6118	\$909.10	\$7,402.05	\$4,573.80	\$21,434.00	\$12,884.95
6142, 6143 & 6144	\$909.10	\$7,402.05	\$4,573.80	\$22,687.00	\$12,884.95
6145, 6146 & 6147	\$909.10	\$7,402.05	\$4,573.80	\$22,706.00	\$12,884.95
6560, 6561 & 6562	\$909.10	\$4,112.25	\$2,541.00	\$21,834.00	\$7,562.35
6563 & 6564	\$909.10	\$2,741.50	\$1,694.00	\$20,163.00	\$5,344.60
6576 & 6577	\$909.10	\$4,934.70	\$3,049.20	\$22,741.00	\$8,893.00
6592	\$3,211.35	\$2,467.35	\$1,524.60	\$0.00	\$7,203.30

### 3 ECIP PROJECT 1: INFRA-RED HEAT AT 36 BUILDINGS

FY94 LIMITED ENERGY STUDY (GLASS), FT. KNOX, KY

This section contains the project description and the DD 1391 Forms for ECIP Project 1: Infra-red Heat at 36 Buildings. Following the DD 1391 Forms is a project summary table, the life cycle cost analysis for the project, and the life cycle cost analysis, cost estimates, and calculations for each building/area included in the project. This ECIP project can also be broken into two FEMP projects. These FEMP projects are referred to as FEMP Project 1 & 2. Below is a detailed index of the information included in this section.

DD 1391 Forms	3-2
Table 3.1: Project Summary - Infra-red Heat at 36 Buildings	3-6
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FEMP Project 1 LCCA	3-8
FEMP Project 2 LCCA	3-184

<u>Buildings:</u>	<u>Page</u>
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92,94,98,100, & 101	3-30
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483	3-108
484	3-121
485	3-134
486, 486A, 486B & 486HB	3-147
2754 & 2755	3-186
2756 & 2757	3-213
2786 - 2789	3-240
2955, 2959 & 2960	3-292
2961, 2963, & 2964	3-331
2969 & 2972	3-371
2970 & 2971	3-398
2958, 2973, 2974, 2979, & 2980	3-425
Catalog Cut Sheets	3-490

DATE 28 October 1994  
PROJECT NO.: ECIP 1  
PROJECT TITLE: ECIP - Heating Systems  
INSTALLATION: Fort Knox  
LOCATION: Kentucky

PRIMARY FACILITY  
Infrared Heating Systems

\$ 1,685,000

ESTIMATED CONTRACT COST  
CONTINGENCY PERCENT (10%)  
SUBTOTAL  
SUPERVISION, INSPECTION & OVERHEAD (5%)  
DESIGN (5%)  
TOTAL REQUEST  
TOTAL REQUEST (ROUNDED)

\$ 1,392,009  
\$ 139,201  
\$ 1,531,210  
\$ 76,561  
\$ 76,561  
\$ 1,684,331  
\$ 1,685,000

Modernize heating systems in 36 high and low bay buildings on Fort Knox with infra-red heaters. This project will perform the following energy engineering improvements to the heating systems.

1). Replace the existing hot water and steam heating systems with infra-red heaters. This includes all areas heated by the existing boiler systems in the 36 buildings. Construction costs include the demolition of the existing heating systems.

2). All infra-red heating systems will be natural gas with electric ignition. The construction costs include bring the natural gas distribution systems to the buildings currently served by fuel oil. This will eliminate the need for underground fuel tanks at these 36 facilities.

DATE 28 October 1994  
PROJECT NO.: ECIP 1  
PROJECT TITLE: ECIP - Heating Systems  
INSTALLATION: Fort Knox  
LOCATION: Kentucky

PROJECT:

Modernize heating systems in 36 high and low bay buildings on Fort Knox with infra-red heaters.

REQUIREMENTS:

Fort Knox operates numerous buildings with outdated, inefficient heating systems. The low efficiency on the existing systems allows wasted usage throughout the heating seasons. These inefficient heating systems drive up the consumption of fuel oil and increase the dependency on foreign oil supplies. The US Army Corps of Engineers, Louisville District, contracted an Energy Engineering Analysis Program to study the heating systems in 36 buildings on Fort Knox. The study identified energy conservation opportunities and performed a life-cycle cost analysis on each opportunity to determine its discounted savings-to-investment ratio (SIR) and estimated payback period. This project capitalizes on identified energy savings opportunities with an SIR greater than 1.25 and a payback period of no more than 10 years.

CURRENT SITUATION:

Numerous Fort Knox facilities currently operate with inefficient heating systems. Many of the buildings in this project are high-bay maintenance facilities with hot water and steam unit heaters. Many of these buildings set the thermostats at 65 to 75°F in the effort to keep occupants warm. These facilities consume more energy than is necessary for their operation. Many of these facilities use fuel oil as their fuel source. Natural gas is a less expensive and cleaner fuel source.

IMPACT IF NOT PROVIDED:

If this project is not provided, 36 buildings will continue to operate with inefficient heating systems, consuming unnecessary energy. The U.S. Army will fail to realize an estimated \$240K in annual savings (FY95\$) and a total discounted savings of \$4.42M in the twenty year life of the project.

ADDITIONAL:

A life cycle cost analysis was performed on each portion of this project and on the overall project. The overall project will realize an energy savings worth over 2.5 times the initial investment cost and will pay for itself in less than 6.5 years.

Fort Knox is not on the list of installations considered for closure or realignment.



DATE 28 October 1994  
PROJECT NO.: ECIP 1  
PROJECT TITLE: ECIP - Heating Systems  
INSTALLATION: Fort Knox  
LOCATION: Kentucky

SECTION 11 - ECONOMIC ANALYSIS DATA

11D ECONOMIC JUSTIFICATION SUMMARY

This energy conservation project is recommended for funding. A life cycle cost analysis was performed on each portion of this project and on the overall project. The overall project will realize an energy savings worth over 2.5 times the initial investment cost and will pay for itself in less than 6.5 years.

DATE 28 October 1994  
PROJECT NO.: ECIP 1  
PROJECT TITLE: ECIP - Heating Systems  
INSTALLATION: Fort Knox  
LOCATION: Kentucky

Source:

Project investment costs and projected energy and non-energy savings are developed in an Energy Engineering Analysis Program (EEAP) developed in 1994 by Systems Engineering and Management Corporation under contract with the U.S. Army Corps of Engineers, Mobile District. Projected energy savings are based on an energy usage survey conducted at Fort Knox and on actual FY94 energy costs to the installation. Investment costs are inflated to reflect FY95 construction costs.

**TABLE 3.1**  
**PROJECT SUMMARY:**  
**INFRA-RED HEAT - ECIP PROJECT 1**  
**(INCLUDING FEMP 1 & 2)**

ECO NUMBER	BUILDING NUMBER	BASELINE ENERGY (MBTU)	ECO ENERGY (MBTU)	ENERGY SAVINGS (MBTU)	1ST YEAR SAVINGS	INVESTMENT COST	NON-ENERGY ANNUAL RECURRING	TOTAL NON-ENERGY NON-RECURRING	SPB (YR)	SIR
1	86	4,014	1,969	2,045	\$9,887	\$49,565	\$0	\$8,773	5.01	4.13
1	92, 94, 98, 100 & 101	17,441	8,554	8,887	\$62,199	\$292,227	\$2,370	\$36,708	3.66	4.30
1	482	2,379	1,167	1,212	\$12,479	\$74,902	\$790	\$27,605	6.00	2.65
1	483	2,385	1,170	1,215	\$12,550	\$74,902	\$790	\$28,483	5.97	2.66
1	484	2,408	1,181	1,227	\$7,027	\$74,902	\$790	\$11,357	10.66	1.85
1	485	2,374	1,165	1,210	\$12,461	\$74,902	\$790	\$27,605	6.01	2.65
1	486A, 486B & 486HB	5,042	2,473	2,569	\$25,713	\$158,261	\$790	\$61,413	6.16	2.59
1	FEMP PROJECT 1	36,043	17,678	18,365	\$159,912	\$803,262	\$6,320	\$201,943	5.02	3.24
1	2754 & 2755	1,822	894	928	\$10,419	\$66,417	\$990	\$30,647	6.37	2.49
1	2756 & 2757	1,822	894	928	\$10,414	\$66,417	\$990	\$30,559	6.38	2.49
1	2786 - 2789	3,177	1,558	1,619	\$10,387	\$121,125	\$990	\$38,358	11.66	1.65
1	2955, 2959 & 2960	3,455	1,695	1,761	\$10,643	\$111,176	\$990	\$30,374	10.45	1.87
1	2961, 2963 & 2964	3,340	1,638	1,702	\$16,755	\$117,512	\$990	\$25,770	7.01	2.23
1	2969 & 2972	2,073	1,017	1,056	\$11,910	\$78,484	\$990	\$38,682	6.59	2.40
1	2970 & 2971	2,073	1,017	1,056	\$11,896	\$78,484	\$990	\$38,407	6.60	2.40
1	2958, 2973, 2974, 2979 & 2980	7,385	3,622	3,763	\$22,401	\$241,454	\$1,980	\$60,749	10.78	1.82
1	FEMP PROJECT 2	25,148	12,334	12,813	\$104,825	\$881,069	\$8,910	\$293,547	8.41	2.06
1	ECIP PROJECT 1 INCL. FEMP 1 & 2	61,190	30,012	31,178	\$264,736	\$1,684,331	\$1,532	\$495,490	6.36	2.62

**TABLE 3.1**  
**PROJECT SUMMARY:**  
**INFRA-RED HEAT - ECIP PROJECT 1**  
**(INCLUDING FEMP 1 & 2)**

ECO NUMBER	BUILDING NUMBER	BASELINE ENERGY (MJ)	ECO ENERGY (MJ)	ENERGY SAVINGS (MJ)	1ST YEAR SAVINGS	INVESTMENT COST	NON-ENERGY ANNUAL RECURRING	TOTAL NON-ENERGY NON-RECURRING	SPB (YR)	SIR
1	86	4,234,411	2,076,841	2,157,570	\$9,887	\$49,565	\$0	\$8,773	5.01	4.13
1	92, 94, 98, 100 & 101	18,400,171	9,024,692	9,375,479	\$62,199	\$292,227	\$2,370	\$36,708	3.66	4.30
1	482	2,509,370	1,230,763	1,278,607	\$12,479	\$74,902	\$790	\$27,605	6.00	2.65
1	483	2,515,953	1,233,991	1,281,962	\$12,550	\$74,902	\$790	\$28,483	5.97	2.66
1	484	2,540,830	1,246,198	1,294,633	\$7,027	\$74,902	\$790	\$11,357	10.66	1.85
1	485	2,505,003	1,228,621	1,276,381	\$12,461	\$74,902	\$790	\$27,605	6.01	2.65
1	486A, 486B & 486HB	5,319,226	2,608,910	2,710,316	\$25,713	\$158,261	\$790	\$61,413	6.16	2.59
1	FEMP PROJECT 1	38,024,964	18,650,016	19,374,948	\$159,912	\$803,262	\$6,320	\$201,943	5.02	3.24
1	2754 & 2755	1,922,105	942,727	979,378	\$10,419	\$66,417	\$990	\$30,647	6.37	2.49
1	2756 & 2757	1,922,105	942,727	979,378	\$10,414	\$66,417	\$990	\$30,559	6.38	2.49
1	2786 - 2789	3,351,777	1,643,943	1,707,834	\$10,387	\$121,125	\$990	\$38,358	11.66	1.65
1	2955, 2959 & 2960	3,645,320	1,787,909	1,857,412	\$10,643	\$111,176	\$990	\$30,374	10.45	1.87
1	2961, 2963 & 2964	3,523,890	1,728,354	1,795,536	\$16,755	\$117,512	\$990	\$25,770	7.01	2.23
1	2969 & 2972	2,187,353	1,072,830	1,114,523	\$11,910	\$78,484	\$990	\$38,682	6.59	2.40
1	2970 & 2971	2,187,353	1,072,830	1,114,523	\$11,896	\$78,484	\$990	\$38,407	6.60	2.40
1	2958, 2973, 2974, 2979 & 2980	7,790,753	3,821,126	3,969,627	\$22,401	\$241,454	\$1,980	\$60,749	10.78	1.82
1	FEMP PROJECT 2	26,530,655	13,012,444	13,518,211	\$104,825	\$881,069	\$8,910	\$293,547	8.41	2.06
1	ECIP PROJECT 1	64,555,619	31,662,460	32,893,159	\$264,736	\$1,684,331	\$1,532	\$495,490	6.36	2.62
	INCL. FEMP 1 & 2									

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: PRJT12  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: PRJT12      ECIP PROJECT 1 - INFRARED HEAT  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	1531210.	
B. SIOH	\$	76561.	
C. DESIGN COST	\$	76561.	
D. TOTAL COST (1A+1B+1C)	\$	1684331.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		1684331.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	40751.	\$ 268958.	17.56	\$ 4722903.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-9573.	\$ -44226.	20.96	\$ -926980.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		31178.	\$ 224732.		\$ 3795923.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 15230.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 224490.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 126084.	5	.86	108433.
2. REPAIR2	\$ 126084.	15	.63	79433.
3. REPAIR3	\$ 26966.	7	.81	21842.
4. REPAIR4	\$ 26966.	14	.65	17528.
5. ENVIR	\$ 189389.	3	.91	172344.
d. TOTAL	\$ 495490.			399580.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 624070.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 264736.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.36 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 4419993.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.62  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.20 %

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: PRJT1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4 CENSUS: 3  
 PROJECT NO. & TITLE: PRJT1 FEMP PROJECT 1 - INFRARED HEAT  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	730238.	
B. SIOH	\$	36512.	
C. DESIGN COST	\$	36512.	
D. TOTAL COST (1A+1B+1C)	\$	803262.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		803262.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	29621.	\$ 195496.	17.56	\$ 3432908.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-11256.	\$ -52001.	20.96	\$ -1089949.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		18365.	\$ 143495.		\$ 2342959.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$ 6320.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 93157.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 37374.	5	.86	32142.
2. REPAIR2	\$ 37374.	15	.63	23546.
3. REPAIR3	\$ 9575.	7	.81	7756.
4. REPAIR4	\$ 9575.	14	.65	6224.
5. ENVIR	\$ 108044.	3	.91	98320.

d. TOTAL	\$ 201943.	167987.
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C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)	\$ 261144.
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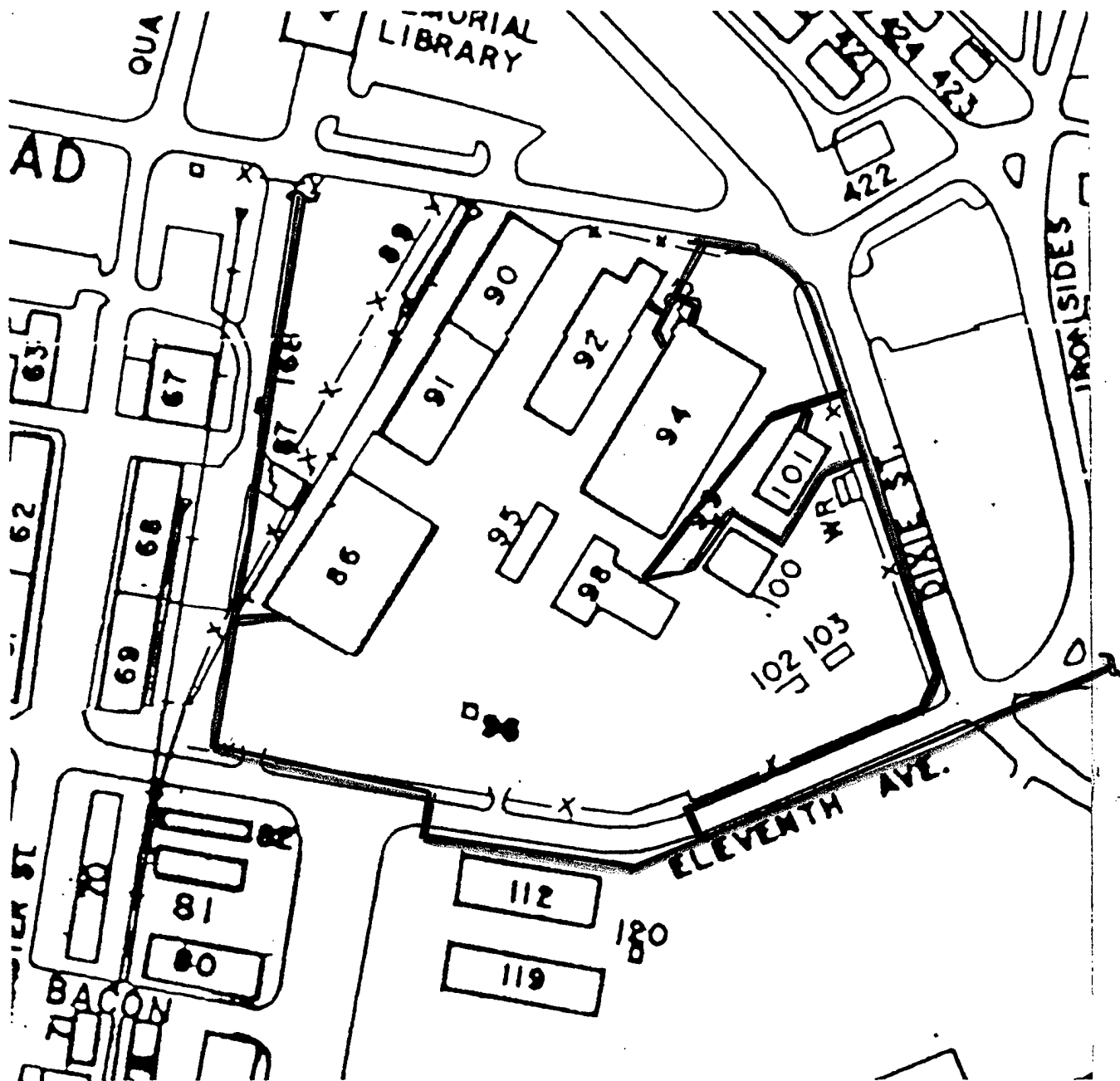
4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))	\$ 159912.
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5. SIMPLE PAYBACK PERIOD (1G/4)	5.02 YEARS
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6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)	\$ 2604103.
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7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)=	3.24
(IF < 1 PROJECT DOES NOT QUALIFY)	

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	9.34 %
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### DPW AREA

——— EXISTING NG MAIN  
 - - - PROPOSED NG MAIN

**SYSTEMS***corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION  
KNOXVILLE, TENNESSEE 37919

## FT. KNOX GLASS STUDY NEW NATURAL GAS LINES REQUIRED

DRAWN BY	B. YATES	JOB NO.	94013.02	SHEET NO.
CHECKED BY	J. HOLLENSBE	DATE	10-07-94	

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 86ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS.      LCCID 1.080  
 PROJECT NO. & TITLE: 86ECO1 ECO-1 INFRA-RED HEAT      4 CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	45059.		
B. SIOH	\$	2253.		
C. DESIGN COST	\$	2253.		
D. TOTAL COST (1A+1B+1C)	\$	49565.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.		
F. PUBLIC UTILITY COMPANY REBATE	\$	0.		
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			49565.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	2045.	\$ 9448.	20.96	\$ 198037.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		2045.	\$ 9448.		\$ 198037.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)		
(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 0.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 0.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS (+) / COST (-) (4)
	(1)	(2)	(3)	
1. REPAIR	\$ 4386.	5	.86	3772.
2. REPAIR2	\$ 4386.	15	.63	2763.
d. TOTAL	\$ 8773.			6536.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 6536.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 9887.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 204572.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 4.13  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.67 %



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Estimate:      BLDG 86           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   *****         City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					250.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		37.50	\$0	\$789	\$321	\$0	\$1,110
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					2.00 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		29.09	\$0	\$761	\$0	\$0	\$761
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					8.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.71	\$0	\$14	\$5	\$0	\$19
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					110.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		1.10	\$0	\$26	\$26	\$0	\$52
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					2.50 C.Y.	
Unit values		0.16	2.43	3.37	1.37	0.00	7.17
Totals		0.40	\$6	\$8	\$3	\$0	\$17
0260120500	BEDDING, PLACING IN TRENCH					2.50 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.22	\$0	\$4	\$2	\$0	\$6
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					1.00 Ea.	

17-Oct-94

## MeansData for Lotus

Page 2

Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	7.37	\$83	\$163	\$0	\$0	\$246
0268520600	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 2"DIAM					
Unit values	0.11	2.19	3.18	0.19	0.00	5.55
Totals	5.70	\$109	\$159	\$9	\$0	\$277

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Line #      Description
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              Manhours   Matl      Labor    Equipment   Sub      Total
=====
U02 SITEWORK      118        $458      $2,909      $487        $0      $3,854

1554510245      HTG INFA-RD UNT GAS ELEC IGN  (See Attached for Breakdown
                                     1.00 LS
Unit values      0.00        0.00        0.00        0.00    33021.00    33021.00
Totals           0.00        $0          $0          $0      $33,021    $33,021

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53      226.00      12.10        0.00        0.00    238.10
Totals           0.53      $226        $12          $0          $0      $238

1562600139      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 2" PIPE SIZE
Unit values      0.73      420.00      16.42        0.00        0.00    436.42
Totals           0.73      $420        $16          $0          $0      $436

1562600140      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 2-1/2" PIPE SIZE
Unit values      1.07      820.00      21.63        0.00        0.00    841.63
Totals           0.00        $0          $0          $0          $0      $0

1562600142      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 4" PIPE SIZE
Unit values      2.00     1450.00      40.85        0.00        0.00    1490.85
Totals           0.00        $0          $0          $0          $0      $0

U15 MECHANICAL      2        $646      $28          $0      $33,021    $33,695

```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	120	\$1,104	\$2,937	\$487	\$33,021	\$37,549
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,104	\$2,937	\$487	\$33,021	\$37,549
CONTINGENCY	10.00%					\$3,755
BOND	0.00%					\$0
PROFIT	10.00%					\$3,755
JOB TOTAL						\$45,059

```

=====
Estimate:      BLDG 86           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY    Job #:      94013.02
Sq. footage:   *****        City indx: Louisville, KY
=====

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## SUMMARY

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-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      118       $458    $2,909      $487         $0     $3,854
U15 MECHANICAL     2        $646      $28         $0     $33,021   $33,695

TOTAL             120      $1,104    $2,937      $487     $33,021   $37,549

SALES TAX          0.00%         $0
MATL MARKUP        0.00%         $0
LABOR MARKUP       0.00%         $0
EQUIPT MARKUP     0.00%         $0
SUB MARKUP         0.00%         $0

TOTAL BEFORE CONTINGENC $1,104    $2,937      $487     $33,021   $37,549
CONTINGENCY        10.00%                $3,755
BOND               0.00%                $0
PROFIT            10.00%                $3,755

JOB TOTAL                                     $45,059

```

=====

Estimate:	BLDG 86	Date:	12-Oct-94
Description:	INFRARED HEATING SYSTEM COST ESTIMATE		
Project:	LIMITED EEAP (GLASS Bid Date:		
Location:	FORT KNOX, KY	Job #:	94013.02
Sq. footage:	City indx: Louisville, KY		

=====

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
-----							
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					609.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		90.74	\$1,349	\$2,785	\$0	\$0	\$4,134
A09 ELECTRICAL		91	\$1,349	\$2,785	\$0	\$0	\$4,134

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	609.00 L.F.	14.47
Totals	270.40	\$2,540	\$6,274	\$0	\$0	\$8,814
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	609.00 L.F.	4.52
Totals	77.34	\$999	\$1,751	\$0	\$0	\$2,750
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	86.00 Ea.	43.59
Totals	43.00	\$3,422	\$327	\$0	\$0	\$3,749
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	2.00 Ea.	858.50
Totals	6.00	\$1,477	\$240	\$0	\$0	\$1,717
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	12.00 Ea.	904.06
Totals	12.00	\$10,320	\$529	\$0	\$0	\$10,849
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	2.00 Ea.	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	411	\$18,908	\$9,176	\$0	\$0	\$28,084

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      2.00 Ea.
Totals           5.93    $662     $141      $0      0.00    401.34
                                   $0      $0      $803

U16 ELECTRICAL      6      $662     $141      $0      $0      $803
```



18-Oct-94

MeansData for Lotus

Page 4

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=====
Line #      Description
-----
              Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	508	\$20,919	\$12,102	\$0	\$0	\$33,021
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$20,919	\$12,102	\$0	\$0	\$33,021
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$33,021

```

=====
Estimate:      BLDG 86          Date:      12-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY    Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      91    $1,349    $2,785          $0    $0    $4,134
U15 MECHANICAL    411    $18,908    $9,176          $0    $0   $28,084
U16 ELECTRICAL      6     $662     $141           $0    $0    $803
TOTAL              508   $20,919   $12,102          $0    $0   $33,021

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $20,919   $12,102          $0    $0   $33,021
CONTINGENCY          0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $33,021

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING HEATING TEMPERATURE SETPOINT: 66 F										PAGE 1 OF 3																		
OUTSIDE DESIGN TEMPERATURE 1 F																												
TEMPERATURE DIFFERENCE 65 F																												
INFILTRATION LOSSES =										1	AIR CHGS	X	375594	VOL (CU FT)	X	65	F TEMP DIFF	X	0.019	=	0.46	MBTU / HR						
FLOOR LOSSES =										478	LINEAR FEET OF PERIMETER										X	65	F TEMP DIFF	X	0.81	=	0.03	MBTU / HR
SURFACE HEAT LOSSES																												
SLOPED WOOD ROOF =										14278	AREA (SF)	X	0.433	U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.40	MBTU / HR						
8" RED BRICK WALL =										9954	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.22	MBTU / HR						
8" CINDER BLOCK WALL =											AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
CORR MTL PNL WALL =											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
CLR SGL PANE WINDOWS =										3552	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.29	MBTU / HR						
METAL ROLL UP DOORS =										448	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR						
METAL OVERHEAD DOORS =											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
LG WOOD SLIDING DOOR =											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						
											AREA (SF)	X		U VALUE (BTU/HR - SF - F)		X	65	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR						

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 86		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3		
		OUTSIDE DESIGN TEMPERATURE 1 F							
		TEMPERATURE DIFFERENCE 54 F							
INFILTRATION LOSSES =		1	AIR CHGS X	375594	VOL (CU FT) X	54 F TEMP DIFF X	0.019	= 0.39	MBTU / HR
FLOOR LOSSES =		478	LINEAR FEET OF PERIMETER X		54 F TEMP DIFF X	0.81	= 0.02	MBTU / HR	
SURFACE HEAT LOSSES									
SLOPED WOOD ROOF =		14278	AREA (SF) X	0.433	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.33	MBTU / HR	
8" RED BRICK WALL =		9954	AREA (SF) X	0.341	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.18	MBTU / HR	
8" CINDER BLOCK WALL =		0	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR	
CLR SGL PANE WINDOWS =		3552	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.24	MBTU / HR	
METAL ROLL UP DOORS =		448	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.01	MBTU / HR	
METAL OVERHEAD DOORS =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR	
LG WOOD SLIDING DOOR =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR	
		=	0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	= 0.00	MBTU / HR	
		=	0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	= 0.00	MBTU / HR	
		=	0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	= 0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES							= 1.17	MBTU / HR	
							= 1,238.40	MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	86	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.018=CONSTANT
HTG TEMP SETPOINT (F)	66	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	1.17	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	1.41	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$4.62	\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	1.41	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	4,013.66	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
	4,013.66	MBTU/YR	X	CORR FACTOR	1				=	4,013.66	MBTU/YR
ECO - 1 =	1.17	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,968.57	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,968.57	MBTU/YR	X	CORR FACTOR	1				=	1,968.57	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	2,045.09	MBTU/YR
									=	2,157,567.73	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	4,013.66	MBTU / YR	X	4.62	\$ /MBTU	=	18,543.10	\$ /YR
ECO - 1 =	1,968.57	MBTU / YR	X	4.62	\$ /MBTU	=	9,094.80	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS						=	9,448.31	\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: DPWECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: DPWECO1      ECO-1 INFRA-RED HEAT  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	265661.	
B. SIOH	\$	13283.	
C. DESIGN COST	\$	13283.	
D. TOTAL COST (1A+1B+1C)	\$	292227.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		292227.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	17441.	\$ 115110.	17.56	\$ 2021333.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-8554.	\$ -39520.	20.96	\$ -828349.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		8887.	\$ 75590.		\$ 1192984.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$	2370.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	34934.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 15627.	5	.86	13439.
2. REPAIR2	\$ 15627.	15	.63	9845.
3. REPAIR3	\$ 2727.	7	.81	2209.
4. REPAIR4	\$ 2727.	14	.65	1773.

d. TOTAL      \$ 36708.      27265.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 62199.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 79795.

5. SIMPLE PAYBACK PERIOD (1G/4) 3.66 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1255184.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 4.30  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.89 %

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Estimate:      DPW AREA          Date:      06-Aug-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   MAIN GAS LINE     City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205541750	PAVEMENT REMOVAL, BITUMINOUS, 4" TO 6" THICK						
	(qty) S.Y.						
Unit values	0.10	0.00	2.09	3.02	0.00	5.11	
Totals	0.00	\$0	\$0	\$0	\$0	\$0	
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED						
	30.00 C.Y.						
Unit values	4.21	0.00	92.52	133.64	0.00	226.16	
Totals	126.33	\$0	\$2,776	\$4,009	\$0	\$6,785	
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD						
	30.00 C.Y.						
Unit values	0.09	0.00	1.74	0.67	0.00	2.41	
Totals	2.67	\$0	\$52	\$20	\$0	\$72	
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D						
	400.00 L.F.						
Unit values	0.01	0.00	0.24	0.24	0.00	0.47	
Totals	4.00	\$0	\$95	\$95	\$0	\$190	
0222700100	HORZ BORNG >100' RDWK .5"WALL, 24"DIA CASING						
	(qty) L.F.						
Unit values	6.40	27.58	139.81	105.88	0.00	273.27	
Totals	0.00	\$0	\$0	\$0	\$0	\$0	
0251040380	ASPHALTIC CONCRETE PAVEMENT, PAVING, WEARING COURSE, 2" THICK						
	(qty) S.Y.						
Unit values	0.02	1.90	0.33	0.30	0.00	2.53	
Totals	0.00	\$0	\$0	\$0	\$0	\$0	
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK						
	44.00 S.Y.						
Unit values	0.05	17.52	1.07	1.02	0.00	19.61	
Totals	2.16	\$771	\$47	\$45	\$0	\$863	
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK						
	7.50 C.Y.						
Unit values	0.16	2.43	3.37	1.37	0.00	7.17	
Totals	1.20	\$18	\$25	\$10	\$0	\$53	
0260120500	BEDDING, PLACING IN TRENCH						

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Unit values	0.09	0.00	1.74	0.67	7.50 C.Y.	
Totals	0.67	\$0	\$13	\$5	0.00	2.41
					\$0	\$18

0266907800 CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER

Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	
Totals	1.56	\$260	\$35	\$6	0.00	300.98
					\$0	\$301

0268520200 GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-  
PSI 2" DIAM COIL SDR 11

Unit values	0.07	0.75	1.48	0.00	400.00 L.F.	
Totals	26.80	\$301	\$592	\$0	0.00	2.23
					\$0	\$893



```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub      Total
=====
U02 SITEWORK      166    $1,350    $3,635    $4,190        $0    $9,175
1562600139      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
      TYPE 2" PIPE SIZE
Unit values      0.73    420.00    16.42        0.00    1.00 Ea.
Totals           0.73    $420        $16        $0        $0    436.42
                                   $436

U15 MECHANICAL      1      $420        $16        $0        $0    $436
=====
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	167	\$1,770	\$3,651	\$4,190	\$0	\$9,611
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,770	\$3,651	\$4,190	\$0	\$9,611
CONTINGENCY	10.00%					\$961
BOND	0.00%					\$0
PROFIT	10.00%					\$961
JOB TOTAL						\$11,533

```

=====
Estimate:      DPW AREA          Date:      06-Aug-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   MAIN GAS LINE     City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
      Manhours   Matl   Labor   Equipment   Sub   Total
=====
U02 SITEWORK      166   $1,350   $3,635   $4,190       $0   $9,175
U15 MECHANICAL     1    $420    $16      $0       $0    $436
TOTAL             167   $1,770   $3,651   $4,190       $0   $9,611

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,770   $3,651   $4,190       $0   $9,611
CONTINGENCY        10.00%      $961
BOND               0.00%      $0
PROFIT            10.00%      $961

JOB TOTAL                                     $11,533

```

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=====
Estimate:      BLDG 92                      Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY              Job #:      94013.02
Sq. footage:    *****                  City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					4.00 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		16.84	\$0	\$370	\$535	\$0	\$905
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					450.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		67.50	\$0	\$1,420	\$578	\$0	\$1,998
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.75 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		10.91	\$0	\$285	\$0	\$0	\$285
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					375.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		26.63	\$0	\$740	\$89	\$0	\$829
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					80.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		16.00	\$0	\$444	\$54	\$0	\$498
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					4.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.36	\$0	\$7	\$3	\$0	\$10
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					50.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		0.50	\$0	\$12	\$12	\$0	\$24
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					6.00 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		0.29	\$105	\$6	\$6	\$0	\$117
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.00 C.Y.	

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Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.16	\$2	\$3	\$1	\$0	\$6
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	1.00 C.Y.	2.41
Totals	0.09	\$0	\$2	\$1	\$0	\$3
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	50.00 L.F.	2.23
Totals	3.35	\$38	\$74	\$0	\$0	\$112
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	40.00 L.F.	5.06
Totals	4.28	\$77	\$118	\$7	\$0	\$202

```

=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      149      $482    $3,516    $1,292      $0    $5,290
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00    32445.00    32445.00
Totals           0.00      $0        $0        $0    $32,445    $32,445
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE      1.00 Ea.
Unit values      0.53     226.00     12.10      0.00      0.00    238.10
Totals           0.53     $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $32,445    $32,683

```

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====

ESTIMATE TOTAL      150      $708    $3,528    $1,292    $32,445    $37,973

SALES TAX            0.00%      $0
MATL MARKUP          0.00%      $0
LABOR MARKUP         0.00%      $0
EQUIPT MARKUP        0.00%      $0
SUB MARKUP           0.00%      $0

TOTAL BEFORE CONTINGENC      $708    $3,528    $1,292    $32,445    $37,973
CONTINGENCY          10.00%      $3,797
BOND                 0.00%      $0
PROFIT               10.00%      $3,797

JOB TOTAL                                     $45,568
```

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=====
Estimate:      BLDG 92          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY    Job #:      94013.02
Sq. footage:   *****        City indx:Louisville, KY
=====

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SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	149	\$482	\$3,516	\$1,292	\$0	\$5,290
U15 MECHANICAL	1	\$226	\$12	\$0	\$32,445	\$32,683
TOTAL	150	\$708	\$3,528	\$1,292	\$32,445	\$37,973
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$708	\$3,528	\$1,292	\$32,445	\$37,973
CONTINGENCY	10.00%					\$3,797
BOND	0.00%					\$0
PROFIT	10.00%					\$3,797
JOB TOTAL						\$45,568



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## MeansData for Lotus

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=====
Estimate:      BLDG 92                      Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY                Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	540.00 L.F.	
Totals		80.46	\$1,196	\$2,469	\$0	0.00	6.79
						\$0	\$3,665
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	75.00 L.F.	
Totals		11.18	\$166	\$343	\$0	0.00	6.79
						\$0	\$509
A09 ELECTRICAL		92	\$1,362	\$2,812	\$0	\$0	\$4,174

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	340.00 L.F.	
Totals	150.96	\$1,418	\$3,503	\$0	\$0	14.47 \$4,921
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	430.00 L.F.	
Totals	54.61	\$705	\$1,237	\$0	\$0	4.52 \$1,942
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	76.00 Ea.	
Totals	38.00	\$3,024	\$289	\$0	\$0	43.59 \$3,313
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	2.00 Ea.	
Totals	6.00	\$1,477	\$240	\$0	\$0	858.50 \$1,717
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	10.00 Ea.	
Totals	10.00	\$8,600	\$441	\$0	\$0	904.06 \$9,041
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
Unit values	4.00	935.00	81.70	0.00	5.00 Ea.	
Totals	20.00	\$4,675	\$409	\$0	\$0	1016.70 \$5,084
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	
Totals	8.00	\$350	\$382	\$0	\$0	146.50 \$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	7.00 Ea.	
Totals	7.00	\$525	\$193	\$0	\$0	102.55 \$718
U15 MECHANICAL	295	\$20,774	\$6,694	\$0	\$0	\$27,468

```
=====
Line #      Description
-----
              Manhours  Matl    Labor  Equipment  Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00      2.00 Ea.
Totals           5.93    $662     $141     $0        0.00    401.34
                                   $0        $0        $803

U16 ELECTRICAL      6      $662     $141     $0        $0        $803
```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====

ESTIMATE TOTAL      393    $22,798    $9,647         $0         $0    $32,445

SALES TAX            0.00%         $0
MATL MARKUP          0.00%         $0
LABOR MARKUP         0.00%         $0
EQUIPT MARKUP        0.00%         $0
SUB MARKUP           0.00%         $0

TOTAL BEFORE CONTINGENC $22,798    $9,647         $0         $0    $32,445
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $32,445
```

```

=====
Estimate:      BLDG 92          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY    Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

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SUMMARY

-----

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	92	\$1,362	\$2,812	\$0	\$0	\$4,174
U15 MECHANICAL	295	\$20,774	\$6,694	\$0	\$0	\$27,468
U16 ELECTRICAL	6	\$662	\$141	\$0	\$0	\$803
TOTAL	393	\$22,798	\$9,647	\$0	\$0	\$32,445
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$22,798	\$9,647	\$0	\$0	\$32,445
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$32,445

```

=====
Estimate:      BLDG 94          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY    Job #:      94013.02
Sq. footage:  *****        City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					4.00 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		16.84	\$0	\$370	\$535	\$0	\$905
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					570.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		85.50	\$0	\$1,799	\$732	\$0	\$2,531
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.75 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		25.45	\$0	\$666	\$0	\$0	\$666
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					375.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		26.63	\$0	\$740	\$89	\$0	\$829
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					4.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.36	\$0	\$7	\$3	\$0	\$10
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					50.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		0.50	\$0	\$12	\$12	\$0	\$24
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					6.00 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		0.29	\$105	\$6	\$6	\$0	\$117
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.00 C.Y.	

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.16	\$2	\$3	\$1	\$0	\$6
0260120500	BEDDING, PLACING IN TRENCH					
					1.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.09	\$0	\$2	\$1	\$0	\$3
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
					1.00 Ea.	
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
					50.00 L.F.	
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	3.35	\$38	\$74	\$0	\$0	\$112
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
					40.00 L.F.	
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	4.28	\$77	\$118	\$7	\$0	\$202

```

=====
Line #      Description
-----
Manhours    Matl      Labor    Equipment    Sub      Total
=====
U02 SITEWORK      185      $482      $4,387      $1,460      $0      $6,329
1554510245      HTG INFA-RD UNT GAS ELEC IGN      (See Attached for Breakdow
                                     1.00 LS.
Unit values      0.00      0.00      0.00      0.00      98265.00      98265.00
Totals           0.00      $0      $0      $0      $98,265      $98,265
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE      1.00 Ea.
Unit values      0.53      226.00      12.10      0.00      0.00      238.10
Totals           0.53      $226      $12      $0      $0      $238
U15 MECHANICAL      1      $226      $12      $0      $98,265      $98,503

```



```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	186	\$708	\$4,399	\$1,460	\$98,265	\$104,832
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$708	\$4,399	\$1,460	\$98,265	\$104,832
CONTINGENCY	10.00%					\$10,483
BOND	0.00%					\$0
PROFIT	10.00%					\$10,483
JOB TOTAL						\$125,798

```

=====
Estimate:      BLDG 94          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY    Job #:      94013.02
Sq. footage:   *****        City indx:Louisville, KY
=====

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## SUMMARY

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-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      185      $482    $4,387    $1,460      $0      $6,329
U15 MECHANICAL     1      $226      $12      $0      $98,265    $98,503
TOTAL              186      $708    $4,399    $1,460    $98,265   $104,832

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $708    $4,399    $1,460    $98,265   $104,832
CONTINGENCY        10.00%      $0
BOND               0.00%      $0
PROFIT            10.00%      $0
JOB TOTAL                                     $125,798

```

```
=====
Estimate:      BLDG 94          Date:      12-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY   Job #:      94013.02
Sq. footage:    City indx: Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					1830.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		272.67	\$4,055	\$8,368	\$0	\$0	\$12,423
A09 ELECTRICAL		273	\$4,055	\$8,368	\$0	\$0	\$12,423

Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					1770.00 L.F.
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	785.88	\$7,381	\$18,235	\$0	\$0	\$25,616
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM					1800.00 L.F.
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	228.60	\$2,952	\$5,176	\$0	\$0	\$8,128
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	261.00 Ea.	43.59
Totals	130.50	\$10,385	\$993	\$0	\$0	\$11,378
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	6.00 Ea.	858.50
Totals	18.00	\$4,430	\$721	\$0	\$0	\$5,151
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	36.00 Ea.	904.06
Totals	36.00	\$30,960	\$1,586	\$0	\$0	\$32,546
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615
U15 MECHANICAL	1205	\$56,558	\$26,876	\$0	\$0	\$83,434

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub      Total
=====
```

1631200100 HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	6.00 Ea. 0.00	401.34
Totals	17.78	\$1,985	\$423	\$0	\$0	\$2,408

U16 ELECTRICAL	18	\$1,985	\$423	\$0	\$0	\$2,408
----------------	----	---------	-------	-----	-----	---------

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	1496	\$62,598	\$35,667	\$0	\$0	\$98,265
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$62,598	\$35,667	\$0	\$0	\$98,265
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$98,265

```

=====
Estimate:      BLDG 94          Date:      12-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY   Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

=====

SUMMARY

-----

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	273	\$4,055	\$8,368	\$0	\$0	\$12,423
U15 MECHANICAL	1205	\$56,558	\$26,876	\$0	\$0	\$83,434
U16 ELECTRICAL	18	\$1,985	\$423	\$0	\$0	\$2,408
TOTAL	1496	\$62,598	\$35,667	\$0	\$0	\$98,265
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$62,598	\$35,667	\$0	\$0	\$98,265
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$98,265

```

=====
Estimate:      BLDG 98           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   8528.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					2.00 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	8.42	\$0	\$185	\$267	\$0		\$452
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					180.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	27.00	\$0	\$568	\$231	\$0		\$799
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.70 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	10.18	\$0	\$266	\$0	\$0		\$266
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					175.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	12.43	\$0	\$345	\$41	\$0		\$386
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					60.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	12.00	\$0	\$333	\$41	\$0		\$374
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					2.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	0.18	\$0	\$3	\$1	\$0		\$4
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					25.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00		0.47
Totals	0.25	\$0	\$6	\$6	\$0		\$12
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					3.00 S.Y.	
Unit values	0.05	17.52	1.07	1.02	0.00		19.61
Totals	0.15	\$53	\$3	\$3	\$0		\$59
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.00 C.Y.	



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MeansData for Lotus

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Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.16	\$2	\$3	\$1	\$0	\$6
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	1.00 C.Y.	2.41
Totals	0.09	\$0	\$2	\$1	\$0	\$3
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	25.00 L.F.	2.23
Totals	1.68	\$19	\$37	\$0	\$0	\$56
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	40.00 L.F.	5.06
Totals	4.28	\$77	\$118	\$7	\$0	\$202

=====

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK		79	\$411	\$1,904	\$605	\$0	\$2,920
1554510245	HTG INFA-RD UNT GAS ELEC IGN						
	(See Attached for Breakdown)						
	1.00 LS.						
Unit values		0.00	0.00	0.00	0.00	26155.00	26155.00
Totals		0.00	\$0	\$0	\$0	\$26,155	\$26,155
1562600137	GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM						
	TYPE 1-1/4" PIPE SIZE						
	1.00 Ea.						
Unit values		0.53	226.00	12.10	0.00	0.00	238.10
Totals		0.53	\$226	\$12	\$0	\$0	\$238
U15 MECHANICAL		1	\$226	\$12	\$0	\$26,155	\$26,393

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	80	\$637	\$1,916	\$605	\$26,155	\$29,313
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$637	\$1,916	\$605	\$26,155	\$29,313
CONTINGENCY	10.00%					\$2,931
BOND	0.00%					\$0
PROFIT	10.00%					\$2,931
JOB TOTAL						\$35,176

```

=====
Estimate:      BLDG 98           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:      LIMITED EEAP (GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  8528.00           City indx: Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      79      $411    $1,904      $605      $0    $2,920
U15 MECHANICAL     1      $226      $12      $0    $26,155    $26,393
TOTAL              80      $637    $1,916      $605    $26,155    $29,313
SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP     0.00%      $0
SUB MARKUP        0.00%      $0
TOTAL BEFORE CONTINGENC $637    $1,916      $605    $26,155    $29,313
CONTINGENCY       10.00%      $2,931
BOND              0.00%      $0
PROFIT            10.00%      $2,931
JOB TOTAL                                     $35,176

```

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=====
Estimate:      BLDG 98           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					400.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		59.60	\$886	\$1,829	\$0	\$0	\$2,715
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					45.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		6.71	\$100	\$206	\$0	\$0	\$306
A09 ELECTRICAL		67	\$986	\$2,035	\$0	\$0	\$3,021

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					400.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	177.60	\$1,668	\$4,121	\$0	\$0	\$5,789
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
					445.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	56.52	\$730	\$1,280	\$0	\$0	\$2,010
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					57.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	28.50	\$2,268	\$217	\$0	\$0	\$2,485
1524105040	VACUUM PUMP AND VENT PIPING					
					2.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	6.00	\$1,477	\$240	\$0	\$0	\$1,717
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					7.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	7.00	\$6,020	\$308	\$0	\$0	\$6,328
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
					3.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	12.00	\$2,805	\$245	\$0	\$0	\$3,050
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					3.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	4.80	\$210	\$229	\$0	\$0	\$439
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					5.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	5.00	\$375	\$138	\$0	\$0	\$513
U15 MECHANICAL	298	\$15,553	\$6,778	\$0	\$0	\$22,331

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## MeansData for Lotus

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```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	2.00 Ea.	
Totals	5.93	\$662	\$141	\$0	0.00	401.34
					\$0	\$803

U16 ELECTRICAL	6	\$662	\$141	\$0	\$0	\$803
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```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====

ESTIMATE TOTAL      371   $17,201   $8,954         $0         $0   $26,155

SALES TAX            0.00%           $0
MATL MARKUP          0.00%           $0
LABOR MARKUP         0.00%           $0
EQUIPT MARKUP        0.00%         $0
SUB MARKUP           0.00%           $0

TOTAL BEFORE CONTINGENC $17,201   $8,954         $0         $0   $26,155
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $26,155
```



```

=====
Estimate:      BLDG 98          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY   Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      67      $986      $2,035      $0      $0      $3,021
U15 MECHANICAL     298     $15,553     $6,778      $0      $0     $22,331
U16 ELECTRICAL       6      $662      $141      $0      $0      $803
TOTAL              371     $17,201     $8,954      $0      $0     $26,155

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $17,201     $8,954      $0      $0     $26,155
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $26,155

```

```

=====
Estimate:      BLDG 100          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  3600.00          City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					4.00 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		16.84	\$0	\$370	\$535	\$0	\$905
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					150.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		22.50	\$0	\$473	\$193	\$0	\$666
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					175.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		12.43	\$0	\$345	\$41	\$0	\$386
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					60.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		12.00	\$0	\$333	\$41	\$0	\$374
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					4.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.36	\$0	\$7	\$3	\$0	\$10
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					50.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		0.50	\$0	\$12	\$12	\$0	\$24
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					6.00 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		0.29	\$105	\$6	\$6	\$0	\$117
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.00 C.Y.	

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## MeansData for Lotus

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Unit values	0.16	2.43	3.37	1.37	0.00		
Totals	0.16	\$2	\$3	\$1	\$0		7.17 \$6
0260120500	BEDDING, PLACING IN TRENCH						
Unit values	0.09	0.00	1.74	0.67	1.00	C.Y.	
Totals	0.09	\$0	\$2	\$1	\$0		2.41 \$3
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER						
Unit values	1.56	259.60	35.47	5.91	1.00	Ea.	
Totals	1.56	\$260	\$35	\$6	\$0		300.98 \$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11						
Unit values	0.07	0.75	1.48	0.00	50.00	L.F.	
Totals	3.35	\$38	\$74	\$0	\$0		2.23 \$112
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIA						
Unit values	0.11	1.92	2.96	0.17	40.00	L.F.	
Totals	4.28	\$77	\$118	\$7	\$0		5.06 \$202

=====						
Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
U02 SITEWORK	82	\$482	\$1,968	\$846	\$0	\$3,296
1554510245	HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)					
Unit values	0.00	0.00	0.00	0.00	1.00 LS.	
Totals	0.00	\$0	\$0	\$0	\$15,872	\$15,872
1562600137	GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM					
	TYPE 1-1/4" PIPE SIZE					
Unit values	0.53	226.00	12.10	0.00	1.00 Ea.	
Totals	0.53	\$226	\$12	\$0	\$0	238.10
						\$238
U15 MECHANICAL	1	\$226	\$12	\$0	\$15,872	\$16,110

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	83	\$708	\$1,980	\$846	\$15,872	\$19,406
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$708	\$1,980	\$846	\$15,872	\$19,406
CONTINGENCY	10.00%					\$1,941
BOND	0.00%					\$0
PROFIT	10.00%					\$1,941
JOB TOTAL						\$23,287

```

=====
Estimate:      BLDG 100           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   3600.00           City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      82    $482    $1,968    $846      $0    $3,296
U15 MECHANICAL    1    $226      $12      $0    $15,872  $16,110
TOTAL              83    $708    $1,980    $846    $15,872  $19,406

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC  $708    $1,980    $846    $15,872  $19,406
CONTINGENCY        10.00%      $0
BOND               0.00%
PROFIT            10.00%      $0
JOB TOTAL                                     $23,287

```

18-Oct-94

MeansData for Lotus

Page 1

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=====
Estimate:      BLDG 100           Date:      12-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx: Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
A09 ELECTRICAL		45	\$665	\$1,372	\$0	\$0	\$2,037

```

=====
Line #      Description
-----
Manhours   Matl    Labor   Equipment   Sub      Total
=====

1517010650  BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM
W/CPLGS                      300.00 L.F.
Unit values    0.44      4.17      10.30      0.00      0.00      14.47
Totals        133.20    $1,251    $3,091      $0         $0        $4,342

1517011310  GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD
FOR CVRG 10'OC 1/2" DIAM    300.00 L.F.
Unit values    0.13      1.64      2.88      0.00      0.00      4.52
Totals        38.10     $492      $863      $0         $0        $1,355

1519010320  ALUMINUM REFLECTORS W/HANGERS
Unit values    0.50      39.79      3.80      0.00      31.00 Ea.  43.59
Totals        15.50     $1,233    $118      $0         $0        $1,351

1524105040  VACUUM PUMP AND VENT PIPING
Unit values    3.00      738.35    120.15      0.00      1.00 Ea.  858.50
Totals        3.00      $738      $120      $0         $0        $858

1552301020  CRV-60 GAS FIRED BURNER 60 MBH & COMBUSTION CHAMBER
Unit values    1.00      860.00    44.06      0.00      6.00 Ea.  904.06
Totals        6.00     $5,160    $264      $0         $0        $5,424

1574205220  ELECTRIC THERMOSTAT W/ COVER AND WIRING
Unit values    1.00      75.00     27.55      0.00      1.00 Ea.  102.55
Totals        1.00      $75       $28      $0         $0        $103

U15 MECHANICAL    197      $8,949    $4,484      $0         $0        $13,433

```



```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34
					\$0	\$402

U16 ELECTRICAL      3      \$331      \$71      \$0      \$0      \$402

18-Oct-94

MeansData for Lotus

Page 4

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	245	\$9,945	\$5,927	\$0	\$0	\$15,872
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$9,945	\$5,927	\$0	\$0	\$15,872
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$15,872

18-Oct-94

## MeansData for Lotus

Page 5

```

=====
Estimate:      BLDG 100      Date:      12-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY  Job #:      94013.02
Sq. footage:  City indx: Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	45	\$665	\$1,372	\$0	\$0	\$2,037
U15 MECHANICAL	197	\$8,949	\$4,484	\$0	\$0	\$13,433
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	245	\$9,945	\$5,927	\$0	\$0	\$15,872
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$9,945	\$5,927	\$0	\$0	\$15,872
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$15,872

```

=====
Estimate:      BLDG 101          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY    Job #:      94013.02
Sq. footage:   5460.00         City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					4.00 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		16.84	\$0	\$370	\$535	\$0	\$905
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					250.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		37.50	\$0	\$789	\$321	\$0	\$1,110
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.75 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		10.91	\$0	\$285	\$0	\$0	\$285
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					175.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		12.43	\$0	\$345	\$41	\$0	\$386
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					60.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		12.00	\$0	\$333	\$41	\$0	\$374
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					4.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.36	\$0	\$7	\$3	\$0	\$10
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					50.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		0.50	\$0	\$12	\$12	\$0	\$24
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					6.00 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		0.29	\$105	\$6	\$6	\$0	\$117
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.00 C.Y.	

17-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.16	\$2	\$3	\$1	\$0	\$6
0260120500	BEDDING, PLACING IN TRENCH					
					1.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.09	\$0	\$2	\$1	\$0	\$3
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
					1.00 Ea.	
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
					50.00 L.F.	
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	3.35	\$38	\$74	\$0	\$0	\$112
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
					40.00 L.F.	
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	4.28	\$77	\$118	\$7	\$0	\$202

```

=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      101      $482    $2,379      $974      $0    $3,835
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals            0.00      $0        $0        $0    16176.00  16176.00
                        $0        $0        $0    $16,176    $16,176
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53      226.00    12.10      0.00      1.00 Ea.
Totals            0.53      $226      $12        $0      0.00    238.10
                        $226      $12        $0      $0    $238
U15 MECHANICAL      1      $226      $12      $0    $16,176    $16,414

```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	102	\$708	\$2,391	\$974	\$16,176	\$20,249
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$708	\$2,391	\$974	\$16,176	\$20,249
CONTINGENCY	10.00%					\$2,025
BOND	0.00%					\$0
PROFIT	10.00%					\$2,025
JOB TOTAL						\$24,299

```

=====
Estimate:      BLDG 101           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5460.00           City indx: Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      101      $482    $2,379      $974      $0      $3,835
U15 MECHANICAL      1      $226      $12      $0      $16,176    $16,414
TOTAL              102      $708    $2,391      $974      $16,176    $20,249

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC  $708    $2,391      $974      $16,176    $20,249
CONTINGENCY         10.00%
BOND                 0.00%
PROFIT               10.00%
JOB TOTAL

```

\$24,299



```
=====
Estimate:      BLDG 101           Date:      12-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
A09 ELECTRICAL		45	\$665	\$1,372	\$0	\$0	\$2,037

Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 300.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	133.20	\$1,251	\$3,091	\$0	\$0	\$4,342
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM 290.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	36.83	\$476	\$834	\$0	\$0	\$1,310
1519010320	ALUMINUM REFLECTORS W/HANGERS 39.00 Ea.					
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	19.50	\$1,552	\$148	\$0	\$0	\$1,700
1524105040	VACUUM PUMP AND VENT PIPING 1.00 Ea.					
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER 6.00 Ea.					
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING 1.00 Ea.					
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	1.00	\$75	\$28	\$0	\$0	\$103
U15 MECHANICAL	200	\$9,252	\$4,485	\$0	\$0	\$13,737

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00      1.00 Ea.
Totals           2.96    $331      $71      $0      0.00    401.34
                                           $0      $402

U16 ELECTRICAL      3      $331      $71      $0      $0      $402
```

```
=====
Line #      Description
-----
              Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	248	\$10,248	\$5,928	\$0	\$0	\$16,176
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$10,248	\$5,928	\$0	\$0	\$16,176
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$16,176

```

=====
Estimate:      BLDG 101           Date:      12-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

=====

SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	45	\$665	\$1,372	\$0	\$0	\$2,037
U15 MECHANICAL	200	\$9,252	\$4,485	\$0	\$0	\$13,737
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	248	\$10,248	\$5,928	\$0	\$0	\$16,176
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$10,248	\$5,928	\$0	\$0	\$16,176
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$16,176

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3												
BUILDING NUMBER:	92	BUILDING HEATING TEMPERATURE SETPOINT:		66 F								
		OUTSIDE DESIGN TEMPERATURE		1 F								
		TEMPERATURE DIFFERENCE		65 F								
INFILTRATION LOSSES =	1	AIR CHGS	X	186300	VOL (CU FT)	X	65	F TEMP DIFF	X 0.019 =	0.23	MBTU / HR	
FLOOR LOSSES =	474	LINEAR FEET OF PERIMETER		X	65	F TEMP DIFF	X 0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES												
SLOPED WOOD ROOF =	12420	AREA (SF)	X	0.433	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.35	MBTU / HR	
8" RED BRICK WALL =	7380	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.16	MBTU / HR	
8" CINDER BLOCK WALL =		AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CORR MTL PNL WALL =		AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CLEAR SGL PANE WINDOWS =	594	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR	
METAL ROLL UP DOORS =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL OVERHEAD DOORS =		AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
LG WOOD SLIDING DOOR =	236	AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL BASELINE HEAT LOSSES										=	0.82	MBTU / HR
										=	860.73	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 92		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3			
		OUTSIDE DESIGN TEMPERATURE								
		TEMPERATURE DIFFERENCE								
		1 F								
		54 F								
INFILTRATION LOSSES =		1	AIR CHGS X	186300	VOL (CU FT) X	54 F TEMP DIFF X	0.019	=	0.19	MBTU / HR
FLOOR LOSSES =		474	LINEAR FEET OF PERIMETER X		54 F TEMP DIFF X	0.81	=	0.02	MBTU / HR	
SURFACE HEAT LOSSES										
SLOPED WOOD ROOF =		12420	AREA (SF) X	0.433	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.29	MBTU / HR	
8" RED BRICK WALL =		7380	AREA (SF) X	0.341	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.14	MBTU / HR	
8" CINDER BLOCK WALL =		0	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CLEAR SGL PANE WINDOWS =		594	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR	
METAL ROLL UP DOORS =		0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL OVERHEAD DOORS =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
LG WOOD SLIDING DOOR =		236	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
=		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES										
								=	0.68	MBTU / HR
								=	715.07	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASLINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.82	0.68
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 92

### GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.018=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	0.82	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,317.54	MBTU/YR
	0.6	SYSEFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,317.54	MBTU/YR	X		CORR FACTOR	1			=	2,317.54	MBTU/YR
	0.68	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,136.68	MBTU/YR
	0.9	SYSEFF	X	54	TEMP DIFFERENCE						
	1,136.68	MBTU/YR	X		CORR FACTOR	1			=	1,136.68	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	1,180.86	MBTU/YR
										1,245,808.47	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	2,317.54	MBTU / YR	X	6.6	\$ /MBTU	=	15,295.77	\$ /YR
ECO - 1 =	1,136.68	MBTU / YR	X	4.62	\$ /MBTU	=	5,251.46	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	10,044.31	\$ /YR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 94		BUILDING HEATING TEMPERATURE SETPOINT: 66 F										PAGE 1 OF 3		
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 65 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	832808	VOL (CU FT)	X	65	F TEMP DIFF	X	0.019	=	1.03	MBTU / HR
FLOOR LOSSES =		751	LINEAR FEET OF PERIMETER		X	65	F TEMP DIFF	X	0.81	=	0.04	MBTU / HR		
SURFACE HEAT LOSSES														
SLOPED WOOD ROOF =		30894	AREA (SF)	X	0.433	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.87	MBTU / HR		
8" RED BRICK WALL =		9232.5	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.20	MBTU / HR		
8" CINDER BLOCK WALL =			AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CORR MTL PNL WALL =			AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLEAR SGL PANE WINDOWS =		14000	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	1.12	MBTU / HR		
METAL ROLL UP DOORS =		2332	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.08	MBTU / HR		
METAL OVERHEAD DOORS =			AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG WOOD SLIDING DOOR =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=			AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
=			AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
=			AREA (SF)	X		U VALUE (BTU/HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL BASELINE HEAT LOSSES												=	3.35	MBTU / HR
												=	3,535.24	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 94		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F						
		TEMPERATURE DIFFERENCE 54 F						
INFILTRATION LOSSES =		1	AIR CHGS X	832808	VOL (CU FT) X	54 F TEMP DIFF X	0.019	= 0.85 MBTU / HR
FLOOR LOSSES =		751	LINEAR FEET OF PERIMETER X		54 F TEMP DIFF X	0.81	= 0.03 MBTU / HR	
SURFACE HEAT LOSSES								
SLOPED WOOD ROOF =		30894	AREA (SF) X	0.433	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.72 MBTU / HR	
8" RED BRICK WALL =		9232.5	AREA (SF) X	0.341	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.17 MBTU / HR	
8" CINDER BLOCK WALL =		0	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
CLEAR SGL PANE WINDOWS =		14000	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.93 MBTU / HR	
METAL ROLL UP DOORS =		2332	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.07 MBTU / HR	
METAL OVERHEAD DOORS =		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
LG WOOD SLIDING DOOR =		0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
MTL/ GLAZED PERSONNEL=		0	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
=		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
=		0	AREA (SF) X	0	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
TOTAL ECO HEAT LOSSES							= 2.78 MBTU / HR	
							= 2,936.97 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	94	GLOSSARY OF TERMS
1 MBTU = 1055 MJ		
0.019=CONSTANT		
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE		
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS		
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2		

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	3.35	2.78
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	3.35	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	9,518.74	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	9,518.74	MBTU/YR	X		CORR FACTOR	1			=	9,518.74	MBTU/YR
	2.78	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	4,668.64	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	4,668.64	MBTU/YR	X		CORR FACTOR	1			=	4,668.64	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	4,850.10	MBTU/YR
									=	5,116,858.76	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	9,518.74	MBTU / YR	X	6.6	\$ /MBTU	=	62,823.68	\$ /YR
ECO - 1 =	4,668.64	MBTU / YR	X	4.62	\$ /MBTU	=	21,569.10	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS						=	41,254.58	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 98		BUILDING HEATING TEMPERATURE SETPOINT: 66 F						PAGE 1 OF 3						
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 65 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	267662	VOL (CU FT)	X	65	F TEMP DIFF	X	0.019	=	0.33	MBTU / HR
FLOOR LOSSES =		443	LINEAR FEET OF PERIMETER		X	65	F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES														
WOOD SLOPED ROOF =		8835	AREA (SF)	X	0.433	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.25	MBTU / HR	
8" RED BRICK WALL =		5981	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.13	MBTU / HR	
8" CINDER BLOCK WALL =			AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CORR MTL PNL WALL =			AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CLR SGL PANE WINDOWS =		3156	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.25	MBTU / HR	
METAL ROLL UP DOORS =		336	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR	
METAL OVERHEAD DOORS =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
MTL GLAZED O'HEAD DR =			AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
LG WOOD SLIDING DOOR =		120	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
WOOD PERSONNEL DR=		25	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
MTL/ GLAZED PERSONNEL=			AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)		X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL BASELINE HEAT LOSSES											=	1.01	MBTU / HR	
											=	1,061.27	MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 98		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3					
		OUTSIDE DESIGN TEMPERATURE 1 F										
		TEMPERATURE DIFFERENCE 54 F										
INFILTRATION LOSSES =	1	AIR CHGS	X	267662	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.27	MBTU / HR
FLOOR LOSSES =	443	LINEAR FEET OF PERIMETER				X	54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR
SURFACE HEAT LOSSES												
WOOD SLOPED ROOF =	8835	AREA (SF)	X	0.433	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.21	MBTU / HR		
8" RED BRICK WALL =	5981	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.11	MBTU / HR		
8" CINDER BLOCK WALL =	0	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CORR MTL PNL WALL =	0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =	3156	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.21	MBTU / HR		
METAL ROLL UP DOORS =	336	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
METAL OVERHEAD DOORS =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL GLAZED O'HEAD DR =	0	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG WOOD SLIDING DOOR =	120	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD PERSONNEL DR=	25	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=	0	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES										=	0.84	MBTU / HR
										=	881.67	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASLINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	1.01	0.84
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 98

GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	1.01	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,857.49	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,857.49	MBTU/YR	X		CORR FACTOR		1		=	2,857.49	MBTU/YR
	0.84	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,401.51	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,401.51	MBTU/YR	X		CORR FACTOR		1		=	1,401.51	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	1,455.98	MBTU/YR
										1,536,061.49	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	2,857.49	MBTU / YR	X	6.6	\$ /MBTU	=	18,859.43	\$ /YR
ECO - 1 =	1,401.51	MBTU / YR	X	4.62	\$ /MBTU	=	6,474.96	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	12,384.47	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 100		BUILDING HEATING TEMPERATURE SETPOINT: 66 F		OUTSIDE DESIGN TEMPERATURE 1 F		TEMPERATURE DIFFERENCE 65 F		PAGE 1 OF 3	
INFILTRATION LOSSES =		1	AIR CHGS X	57600	VOL (CU FT) X	65	F TEMP DIFF X	0.019	= 0.07 MBTU / HR
FLOOR LOSSES =		240	LINEAR FEET OF PERIMETER X		65	F TEMP DIFF X	0.81	= 0.01 MBTU / HR	
SURFACE HEAT LOSSES									
FLAT BUILT UP ROOF =		3600	AREA (SF) X	0.189	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR	
8" RED BRICK WALL =			AREA (SF) X	0.341	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
8" CINDER BLOCK WALL =		3521	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.09 MBTU / HR	
CORR MTL PNL WALL =			AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
CLR SGL PANE WINDOWS =		280	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR	
METAL ROLL UP DOORS =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
METAL OVERHEAD DOORS =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
MTL GLAZED O'HEAD DR =		168	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR	
LG WOOD SLIDING DOOR =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
WOOD PERSONNEL DR=		190	AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR	
MTL/ GLAZED PERSONNEL=			AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
TOTAL BASELINE HEAT LOSSES								= 0.25 MBTU / HR	
								= 266.43 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 100		BUILDING HEATING TEMPERATURE SETPOINT: 55 F				PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
		54 F					
		1 F					
		54 F					



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	100	GLOSSARY OF TERMS
SYSTEM EFFICIENCY			1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	60%	90%	0.019=CONSTANT
HTG TEMP SETPOINT (F)	1	1	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	66	55	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	4616	3396	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	0.25	0.21	
\$ /MBTU -NATURAL GAS	\$6.60	\$6.60	
\$ /MBTU -PPG	\$4.62	\$4.62	
	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.25	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	717.37	MBTU/YR
	0.6	SYSEFF	X	65	TEMP DIFFERENCE						
	717.37	MBTU/YR	X		CORR FACTOR		1		=		717.37
ECO - 1 =	0.21	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	351.84	MBTU/YR
	0.9	SYSEFF	X	54	TEMP DIFFERENCE						
	351.84	MBTU/YR	X		CORR FACTOR		1		=		351.84
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=		365.52
									=		385,624.49
											MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	717.37	MBTU / YR	X	6.6	\$ /MBTU	=	4,734.61	\$ /YR
ECO - 1 =	351.84	MBTU / YR	X	4.62	\$ /MBTU	=	1,625.52	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								3,109.09
								\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3

BUILDING NUMBER: 101 BUILDING HEATING TEMPERATURE SETPOINT: 66 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 65 F

INFILTRATION LOSSES = 1 AIR CHGS X 143850 VOL (CU FT) X 65 F TEMP DIFF X 0.019 = 0.18 MBTU / HR  
FLOOR LOSSES = 314 LINEAR FEET OF PERIMETER X 65 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	6090	AREA (SF) X	0.189	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
8" RED BRICK WALL =	4835	AREA (SF) X	0.341	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.11	MBTU / HR
8" CINDER BLOCK WALL =		AREA (SF) X	0.426	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	3751	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.30	MBTU / HR
METAL ROLL UP DOORS =	1024	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
METAL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL GLAZED O'HEAD DR =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD PERSONNEL DR =		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =		AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL BASELINE HEAT LOSSES

= 0.71 MBTU / HR  
= 753.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 101		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3						
		OUTSIDE DESIGN TEMPERATURE					1 F						
		TEMPERATURE DIFFERENCE					54 F						
INFILTRATION LOSSES =		1	AIR CHGS	X	143850	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.15	MBTU / HR
FLOOR LOSSES =		314	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.01	MBTU / HR		
SURFACE HEAT LOSSES													
FLAT BUILT UP ROOF =		6090	AREA (SF)	X	0.189	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
8" RED BRICK WALL =		4835	AREA (SF)	X	0.341	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR		
8" CINDER BLOCK WALL =		0	AREA (SF)	X	0.426	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =		3751	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.25	MBTU / HR		
METAL ROLL UP DOORS =		1024	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
METAL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL GLAZED O'HEAD DR =		0	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=		0	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES											=	0.59	MBTU / HR
											=	626.28	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	101	GLOSSARY OF TERMS
1 MBTU = 1055 MJ		
0.019=CONSTANT		
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE		
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS		
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2		

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.71	0.59
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.71	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,029.78	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,029.78	MBTU/YR	X		CORR FACTOR	1			=	2,029.78	MBTU/YR
	0.59	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	995.54	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	995.54	MBTU/YR	X		CORR FACTOR	1			=	995.54	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	1,034.24	MBTU/YR
										1,091,119.50	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	2,029.78	MBTU / YR	X	6.6	\$ /MBTU	=	13,396.53	\$ /YR
ECO - 1 =	995.54	MBTU / YR	X	4.62	\$ /MBTU	=	4,599.40	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=						8,797.13	\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 482ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: 482ECO1      ECO-1 INFRARED HEAT      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	68093.	
B. SIOH	\$	3405.	
C. DESIGN COST	\$	3405.	
D. TOTAL COST (1A+1B+1C)	\$	74902.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		74902.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	2379.	\$ 15698.	17.56	\$ 275664.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1167.	\$ -5390.	20.96	\$ -112968.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1212.	\$ 10309.		\$ 162696.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 790.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 11645.

B. NON RECURRING SAVINGS(+) / COSTS (-)

ITEM	SAVINGS(+) / COST(-) (1)	YR OC (2)	DISCNT FACTOR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
1. REPAIR	\$ 2193.	5	.86	1886.
2. REPAIR2	\$ 2193.	15	.63	1382.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 21400.	3	.91	19474.
d. TOTAL	\$ 27605.			24069.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 35714.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 12479.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.00 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 198410.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  2.65  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.25 %

```

=====
Estimate:      BLDG 482           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    *****          City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
1554510245   HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  49240.00  49240.00
Totals           0.00      $0        $0        $0    $49,240  $49,240

U15 MECHANICAL      0        $0        $0        $0    $49,240  $49,240
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL	253		\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%		\$0				
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%						\$5,674
BOND	0.00%						\$0
PROFIT	10.00%						\$5,674
JOB TOTAL							\$68,093



```

=====
Estimate:      BLDG 482           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  *****          City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      253      $0    $6,066    $1,438      $0    $7,504
U15 MECHANICAL      0      $0      $0      $0    $49,240    $49,240
TOTAL              253      $0    $6,066    $1,438    $49,240    $56,744
SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0
TOTAL BEFORE CONTINGENC      $0    $6,066    $1,438    $49,240    $56,744
CONTINGENCY        10.00%      $5,674
BOND                0.00%      $0
PROFIT             10.00%      $5,674
JOB TOTAL                                $68,093

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=====
Estimate:      BLDG 482           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

=====						
Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	925.00 L.F.	
Totals	410.70	\$3,857	\$9,530	\$0	0.00	14.47
					\$0	\$13,387
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	795.00 L.F.	
Totals	100.97	\$1,304	\$2,286	\$0	0.00	4.52
					\$0	\$3,590
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	129.00 Ea.	
Totals	64.50	\$5,133	\$491	\$0	0.00	43.59
					\$0	\$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	3.00 Ea.	
Totals	9.00	\$2,215	\$360	\$0	0.00	858.50
					\$0	\$2,575
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	18.00 Ea.	
Totals	18.00	\$15,480	\$793	\$0	0.00	904.06
					\$0	\$16,273
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	3.00 Ea.	
Totals	3.00	\$225	\$83	\$0	0.00	102.55
					\$0	\$308
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757

```
=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	3.00 Ea.	
Totals	8.89	\$992	\$212	\$0	0.00	401.34
					\$0	\$1,204

U16 ELECTRICAL	9	\$992	\$212	\$0	\$0	\$1,204
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```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

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=====
Estimate:      BLDG 482           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL    138    $2,049    $4,230          $0    $0    $6,279
U15 MECHANICAL    607   $28,214   $13,543          $0    $0   $41,757
U16 ELECTRICAL     9     $992     $212          $0    $0    $1,204
TOTAL              754   $31,255   $17,985          $0    $0   $49,240

SALES TAX          0.00%          $0
MATL MARKUP        0.00%          $0
LABOR MARKUP       0.00%          $0
EQUIPT MARKUP      0.00%          $0
SUB MARKUP         0.00%          $0

TOTAL BEFORE CONTINGENC $31,255   $17,985          $0    $0   $49,240
CONTINGENCY         0.00%
BOND                0.00%
PROFIT              0.00%

JOB TOTAL -                                     $49,240

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 482		BUILDING HEATING TEMPERATURE SETPOINT: 66 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F			
		TEMPERATURE DIFFERENCE 65 F			
INFILTRATION LOSSES =		1	AIR CHGS X	248400	VOL (CU FT) X 65 F TEMP DIFF X 0.019 = 0.31 MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER X	65 F TEMP DIFF X 0.81 = 0.04 MBTU / HR	
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	16215	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR	
FACE BRICK/BLK WALL =	3441	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR	
8" CINDER BLOCK WALL =	3245	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.08 MBTU / HR	
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR	
CLR SGL PANE WINDOWS =	1337	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR	
METAL ROLL UP DOORS =	2940	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR	
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR	
WOOD GLAZED O'HEAD DR =	1274	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.05 MBTU / HR	
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR	
METAL PERSONNEL DR=		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR	
WD/ GLAZED PERSONNEL=	75	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X 65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR	
TOTAL BASELINE HEAT LOSSES				= 0.84 MBTU / HR	
				= 883.39 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 482		BUILDING HEATING TEMPERATURE SETPOINT: 55 F										PAGE 2 OF 3		
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 54 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	248400	VOL (CU FT)	X	54	F TEMP DIFF	X	0.019	=	0.25	MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER		X	54	F TEMP DIFF	X	0.81	=	0.03	MBTU / HR		
SURFACE HEAT LOSSES														
FLAT BUILT UP ROOF =		16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR		
FACE BRICK/BLK WALL =		3441	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
8" CINDER BLOCK WALL =		3245	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR		
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =		1337	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR		
METAL ROLL UP DOORS =		2940	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR		
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD GLAZED O'HEAD DR =		1274	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WD/ GLAZED PERSONNEL=		75	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES												=	0.70	MBTU / HR
												=	733.89	MJ/HR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	482
GLOSSARY OF TERMS	
1 MBTU = 1055 MJ	
0.019=CONSTANT	
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE	
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS	
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2	

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.84	0.70
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.84	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,378.55	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,378.55	MBTU/YR		X	CORR FACTOR		1		=	2,378.55	MBTU/YR
	0.70	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	1,166.60	MBTU/YR
	1,166.60	MBTU/YR		X	CORR FACTOR		1				
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	1,211.95	MBTU/YR
									=	1,278,603.32	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	2,378.55	MBTU / YR	X	6.6	\$ /MBTU	=	15,698.41	\$ /YR
ECO - 1 =	1,166.60	MBTU / YR	X	4.62	\$ /MBTU	=	5,389.70	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								10,308.72
								\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 483ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: 483ECO1      ECO-1 INFRARED HEAT      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	68093.	
B. SIOH	\$	3405.	
C. DESIGN COST	\$	3405.	
D. TOTAL COST (1A+1B+1C)	\$	74902.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		74902.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	2385.	\$ 15740.	17.56	\$ 276388.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1170.	\$ -5404.	20.96	\$ -113264.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1215.	\$ 10336.		\$ 163123.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 790.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 11645.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 2467.	5	.86	2122.
2. REPAIR2	\$ 2467.	15	.63	1554.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 21730.	3	.91	19774.
d. TOTAL	\$ 28483.			24778.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 36423.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 12550.

5. SIMPLE PAYBACK PERIOD (1G/4) 5.97 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 199546.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.66  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.28 %

```

=====
Estimate:      BLDG 483          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY    Job #:      94013.02
Sq. footage:    *****        City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504

17-Oct-94

MeansData for Lotus

Page 2

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=====
Line #      Description
-----
           Manhours   Matl     Labor   Equipment   Sub       Total
=====
1554510245   HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  49240.00  49240.00
Totals           0.00      $0        $0        $0    $49,240  $49,240

U15 MECHANICAL      0        $0        $0        $0    $49,240  $49,240
```

```
=====
Line #      Description
-----
      Manhours   Matl      Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	253	\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%					\$5,674
BOND	0.00%					\$0
PROFIT	10.00%					\$5,674
JOB TOTAL						\$68,093

```

=====
Estimate:      BLDG 483           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

## SUMMARY

```

=====
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      253         $0     $6,066     $1,438         $0     $7,504
U15 MECHANICAL      0         $0         $0         $0     $49,240     $49,240
TOTAL              253         $0     $6,066     $1,438     $49,240     $56,744
SALES TAX          0.00%         $0
MATL MARKUP        0.00%         $0
LABOR MARKUP        0.00%         $0
EQUIPT MARKUP       0.00%         $0
SUB MARKUP          0.00%         $0
TOTAL BEFORE CONTINGENC $0     $6,066     $1,438     $49,240     $56,744
CONTINGENCY         10.00%         $5,674
BOND                 0.00%         $0
PROFIT              10.00%         $5,674
JOB TOTAL                                $68,093

```

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=====
Estimate:      BLDG 483           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	925.00 L.F.	
Totals	410.70	\$3,857	\$9,530	\$0	\$0	14.47 \$13,387
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	795.00 L.F.	
Totals	100.97	\$1,304	\$2,286	\$0	\$0	4.52 \$3,590
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	129.00 Ea.	
Totals	64.50	\$5,133	\$491	\$0	\$0	43.59 \$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	3.00 Ea.	
Totals	9.00	\$2,215	\$360	\$0	\$0	858.50 \$2,575
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	18.00 Ea.	
Totals	18.00	\$15,480	\$793	\$0	\$0	904.06 \$16,273
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	3.00 Ea.	
Totals	3.00	\$225	\$83	\$0	\$0	102.55 \$308
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757



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=====
Line #      Description
-----
           Manhours   Matl     Labor   Equipment   Sub     Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      3.00 Ea.
Totals           8.89    $992     $212      $0        0.00    401.34
                                           $0        $0        $1,204

U16 ELECTRICAL      9      $992     $212      $0        $0        $1,204
```

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

18-Oct-94

## MeansData for Lotus

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=====
Estimate:      BLDG 483      Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	138	\$2,049	\$4,230	\$0	\$0	\$6,279
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757
U16 ELECTRICAL	9	\$992	\$212	\$0	\$0	\$1,204
TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 483		BUILDING HEATING TEMPERATURE SETPOINT: 66 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
		65 F					
		1 F					
		65 F					
INFILTRATION LOSSES =		1	AIR CHGS X	248400	VOL (CU FT) X	65 F TEMP DIFF X	0.019 = 0.31 MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER X	65 F TEMP DIFF X	0.81 =	0.04	MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	16215	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.11 MBTU / HR
FACE BRICK/BLK WALL =	3441	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.03 MBTU / HR
8" CINDER BLOCK WALL =	3245	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.08 MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1337	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.11 MBTU / HR
METAL ROLL UP DOORS =	1470	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.05 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	2744	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.10 MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00 MBTU / HR
WD/ GLAZED PERSONNEL=	75	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES						=	0.84 MBTU / HR
						=	885.71 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 483		BUILDING HEATING TEMPERATURE SETPOINT: 55 F				PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F					
		TEMPERATURE DIFFERENCE 54 F					
INFILTRATION LOSSES =	1	AIR CHGS	X	248400	VOL (CU FT)	X	54 F TEMP DIFF X 0.019 = 0.25 MBTU / HR
FLOOR LOSSES =	780	LINEAR FEET OF PERIMETER	X	54	F TEMP DIFF	X	0.81 = 0.03 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
FACE BRICK/BLK WALL =	3441	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
8" CINDER BLOCK WALL =	3245	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1337	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
METAL ROLL UP DOORS =	1470	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
MTL OVERHEAD DOORS =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	2744	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
LG WOOD SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =	0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =	75	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL ECO HEAT LOSSES						=	0.70 MBTU / HR
						=	735.82 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.84	0.70
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 483

GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.84	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,384.79	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
	2,384.79	MBTU/YR		X	CORR FACTOR		1		=		2,384.79
ECO - 1 =	0.70	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,169.66	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,169.66	MBTU/YR		X	CORR FACTOR		1		=		1,169.66
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=		1,215.13
									=		1,281,959.11
											MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	2,384.79	MBTU / YR	X	6.6	\$ /MBTU	=	15,739.62	\$ /YR
ECO - 1 =	1,169.66	MBTU / YR	X	4.62	\$ /MBTU	=	5,403.84	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								10,335.77
								\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 484ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS.      LCCID 1.080  
 PROJECT NO. & TITLE: 484ECO1      ECO-1 INFRARED HEAT      4 CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	68093.	
B. SIOH	\$	3405.	
C. DESIGN COST	\$	3405.	
D. TOTAL COST (1A+1B+1C)	\$	74902.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		74902.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	1227.	\$ 5669.	20.96	\$ 118830.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1227.	\$ 5669.		\$ 118830.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 790.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 11645.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) / COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
1. REPAIR	\$ 2467.	5	.86	2122.
2. REPAIR2	\$ 2467.	15	.63	1554.
3. REPAIR3	\$ 3211.	7	.81	2601.
4. REPAIR4	\$ 3211.	14	.65	2087.
d. TOTAL	\$ 11357.			8365.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 20009.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 7027.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.66 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 138840.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  1.85  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.33 %

```

=====
Estimate:      BLDG 484           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    *****         City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504



```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====

1554510245   HTG INFA-RD UNT GAS ELEC IGN   (See Attached for Breakdown
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  49240.00  49240.00
Totals           0.00      $0        $0        $0    $49,240  $49,240

U15 MECHANICAL      0        $0        $0        $0    $49,240  $49,240
```

```
=====
Line #      Description
-----
           Manhours  Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	253	\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%					\$5,674
BOND	0.00%					\$0
PROFIT	10.00%					\$5,674
JOB TOTAL						\$68,093

```

=====
Estimate:      BLDG 484           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY     Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      253         $0     $6,066     $1,438         $0     $7,504
U15 MECHANICAL      0         $0         $0         $0     $49,240     $49,240
TOTAL              253         $0     $6,066     $1,438     $49,240     $56,744
SALES TAX          0.00%         $0
MATL MARKUP        0.00%         $0
LABOR MARKUP       0.00%         $0
EQUIPT MARKUP     0.00%         $0
SUB MARKUP         0.00%         $0
TOTAL BEFORE CONTINGENC $0     $6,066     $1,438     $49,240     $56,744
CONTINGENCY        10.00%         $5,674
BOND               0.00%         $0
PROFIT             10.00%         $5,674
JOB TOTAL                                     $68,093

```

```

=====
Estimate:      BLDG 484           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

```

=====
Line #      Description
-----
Manhours   Matl      Labor    Equipment   Sub      Total
=====

1517010650  BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM
W/CPLGS                      925.00 L.F.
Unit values      0.44      4.17      10.30      0.00      0.00      14.47
Totals          410.70     $3,857     $9,530      $0        $0      $13,387

1517011310  GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD
FOR CVRG 10'OC 1/2" DIAM                      795.00 L.F.
Unit values      0.13      1.64      2.88      0.00      0.00      4.52
Totals          100.97     $1,304     $2,286      $0        $0      $3,590

1519010320  ALUMINUM REFLECTORS W/HANGERS
Unit values      0.50      39.79      3.80      0.00      129.00 Ea.  43.59
Totals          64.50     $5,133     $491        $0        $0      $5,624

1524105040  VACUUM PUMP AND VENT PIPING
Unit values      3.00      738.35     120.15      0.00      3.00 Ea.  858.50
Totals          9.00      $2,215     $360        $0        $0      $2,575

1552301020  CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER
Unit values      1.00      860.00      44.06      0.00      18.00 Ea.  904.06
Totals          18.00     $15,480     $793        $0        $0      $16,273

1574205220  ELECTRIC THERMOSTAT W/ COVER AND WIRING
Unit values      1.00      75.00      27.55      0.00      3.00 Ea.  102.55
Totals          3.00      $225       $83        $0        $0      $308

U15 MECHANICAL      607     $28,214     $13,543      $0        $0      $41,757

```

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      3.00 Ea.
Totals           8.89    $992     $212      $0      0.00    401.34
                                   $0      $0      $1,204

U16 ELECTRICAL      9      $992     $212      $0      $0      $1,204
```

```
=====
Line #      Description
-----
           Manhours   Matl      Labor    Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

```

=====
Estimate:      BLDG 484           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL  138    $2,049    $4,230          $0    $0    $6,279
U15 MECHANICAL  607    $28,214   $13,543          $0    $0   $41,757
U16 ELECTRICAL   9      $992      $212          $0    $0    $1,204
TOTAL          754    $31,255   $17,985          $0    $0   $49,240

SALES TAX      0.00%          $0
MATL MARKUP    0.00%          $0
LABOR MARKUP   0.00%          $0
EQUIPT MARKUP  0.00%          $0
SUB MARKUP     0.00%          $0

TOTAL BEFORE CONTINGENC  $31,255   $17,985          $0    $0   $49,240
CONTINGENCY      0.00%
BOND             0.00%
PROFIT           0.00%

JOB TOTAL                                     $49,240

```



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 484		BUILDING HEATING TEMPERATURE SETPOINT: 66 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		65 F	
INFILTRATION LOSSES =	1	AIR CHGS X	248400	VOL (CU FT) X	65 F TEMP DIFF X 0.019 = 0.31 MBTU / HR
FLOOR LOSSES =	780	LINEAR FEET OF PERIMETER X	65	F TEMP DIFF X 0.81 =	0.04 MBTU / HR
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	16215	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR
FACE BRICK/BLK WALL =	3279	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
8" CINDER BLOCK WALL =	3245	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.08 MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1485	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.12 MBTU / HR
METAL ROLL UP DOORS =	3234	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.12 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	994	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =	75	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES				=	0.85 MBTU / HR
				=	894.46 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 484		BUILDING HEATING TEMPERATURE SETPOINT: 55 F												
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 54 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	248400	VOL (CU FT)	X	54 F	TEMP DIFF	X	0.019	=	0.25	MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER		X	54 F	TEMP DIFF	X	0.81	=	0.03	MBTU / HR		
SURFACE HEAT LOSSES														
FLAT BUILT UP ROOF =		16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR	
FACE BRICK/BLK WALL =		3279	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR	
8" CINDER BLOCK WALL =		3245	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CLR SGL PANE WINDOWS =		1485	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.10	MBTU / HR	
METAL ROLL UP DOORS =		3234	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.10	MBTU / HR	
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
WOOD GLAZED O'HEAD DR =		994	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR	
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
WD/ GLAZED PERSONNEL=		75	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES												=	0.70	MBTU / HR
												=	743.09	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	484	GLOSSARY OF TERMS
1 MBTU = 1055 MJ		
0.019=CONSTANT		
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE		
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS		
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2		

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	66	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.85	0.70
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.85	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,408.37	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,408.37	MBTU/YR	X		CORR FACTOR		1		=	2,408.37	MBTU/YR
	0.70	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,181.23	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,181.23	MBTU/YR	X		CORR FACTOR		1		=	1,181.23	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	1,227.14	MBTU/YR
										1,294,632.91	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	2,408.37	MBTU / YR	X	4.62	\$ /MBTU	=	11,126.66	\$ /YR
ECO - 1 =	1,181.23	MBTU / YR	X	4.62	\$ /MBTU	=	5,457.27	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	5,669.39	\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 485ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS.      LCCID 1.080  
 PROJECT NO. & TITLE: 485ECO1      ECO-1 INFRARED HEAT      4 CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	68093.	
B. SIOH	\$	3405.	
C. DESIGN COST	\$	3405.	
D. TOTAL COST (1A+1B+1C)	\$	74902.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		74902.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	2374.	\$ 15671.	17.56	\$ 275185.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1165.	\$ -5380.	20.96	\$ -112771.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1210.	\$ 10291.		\$ 162413.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 790.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 11645.

B. NON RECURRING SAVINGS(+) / COSTS (-)

ITEM	SAVINGS(+) / COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
1. REPAIR	\$ 2193.	5	.86	1886.
2. REPAIR2	\$ 2193.	15	.63	1382.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 21400.	3	.91	19474.
d. TOTAL	\$ 27605.			24069.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 35714.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 12461.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 198127.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.65  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.24 %

```

=====
Estimate:      BLDG 485           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    *****         City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub    Total
=====
1554510245  HTG INFA-RD UNT GAS ELEC IGN  (See Attached for Breakdown
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  49240.00  49240.00
Totals           0.00      $0      $0      $0    $49,240  $49,240

U15 MECHANICAL      0      $0      $0      $0    $49,240  $49,240
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	253	\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%					\$5,674
BOND	0.00%					\$0
PROFIT	10.00%					\$5,674
JOB TOTAL						\$68,093

```

=====
Estimate:      BLDG 485           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    *****         City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
              Manhours   Matl   Labor   Equipment   Sub   Total
=====
U02 SITEWORK      253      $0   $6,066   $1,438      $0   $7,504
U15 MECHANICAL      0      $0      $0      $0   $49,240   $49,240
TOTAL             253      $0   $6,066   $1,438   $49,240   $56,744
SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP     0.00%      $0
SUB MARKUP        0.00%      $0
TOTAL BEFORE CONTINGENC      $0   $6,066   $1,438   $49,240   $56,744
CONTINGENCY       10.00%      $5,674
BOND              0.00%      $0
PROFIT           10.00%      $5,674
JOB TOTAL                                     $68,093

```



```

=====
Estimate:      BLDG 485          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY    Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					925.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	410.70	\$3,857	\$9,530	\$0	\$0	\$13,387
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
					795.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	100.97	\$1,304	\$2,286	\$0	\$0	\$3,590
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					129.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	64.50	\$5,133	\$491	\$0	\$0	\$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
					3.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	9.00	\$2,215	\$360	\$0	\$0	\$2,575
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					18.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	18.00	\$15,480	\$793	\$0	\$0	\$16,273
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					3.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	3.00	\$225	\$83	\$0	\$0	\$308
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub    Total
=====
1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      3.00 Ea.
Totals           8.89      $992      $212      $0      0.00    401.34
                                           $0      $0      $1,204

U16 ELECTRICAL      9      $992      $212      $0      $0      $1,204
```

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

```

=====
Estimate:      BLDG 485          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY    Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	138	\$2,049	\$4,230	\$0	\$0	\$6,279
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757
U16 ELECTRICAL	9	\$992	\$212	\$0	\$0	\$1,204
TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 485		BUILDING HEATING TEMPERATURE SETPOINT: 66 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F					
		TEMPERATURE DIFFERENCE 65 F					
INFILTRATION LOSSES =	1	AIR CHGS	X	248400	VOL (CU FT)	X	65 F TEMP DIFF X 0.019 = 0.31 MBTU / HR
FLOOR LOSSES =	780	LINEAR FEET OF PERIMETER	X	65	F TEMP DIFF	X	0.81 = 0.04 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR
FACE BRICK/BLK WALL =	3416	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
8" CINDER BLOCK WALL =	3050	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.08 MBTU / HR
CORR MTL PNL WALL =		AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1238	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.10 MBTU / HR
METAL ROLL UP DOORS =	3234	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.12 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	1274	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.05 MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =		AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =	100	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES						= 0.84 MBTU / HR	= 881.85 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 485		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3						
		OUTSIDE DESIGN TEMPERATURE 1 F											
		TEMPERATURE DIFFERENCE 54 F											
INFILTRATION LOSSES =		1	AIR CHGS	X	248400	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.25	MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.03	MBTU / HR		
SURFACE HEAT LOSSES													
FLAT BUILT UP ROOF =		16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.09	MBTU / HR		
FACE BRICK/BLK WALL =		3416	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
8" CINDER BLOCK WALL =		3050	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =		1238	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.08	MBTU / HR		
METAL ROLL UP DOORS =		3234	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.10	MBTU / HR		
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD GLAZED O'HEAD DR =		1274	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WD/ GLAZED PERSONNEL=		100	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES											=	0.69	MBTU / HR
											=	732.62	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

SYSTEM EFFICIENCY	BASELINE	ECO - 1
OUTSIDE DESIGN TEMP (F)	60%	90%
HTG TEMP SETPOINT (F)	1	1
HEATING DEGREE DAYS	66	55
TOTAL HEAT LOSSES (MBTU / HR)	4616	3396
\$ /MBTU -FUEL OIL	0.84	0.69
\$ /MBTU -NATURAL GAS	\$6.60	\$6.60
\$ /MBTU -PPG	\$4.62	\$4.62
	\$10.84	\$10.84

BUILDING NUMBER 485

GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.84	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,374.41	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,374.41	MBTU/YR		X	CORR FACTOR		1		=	2,374.41	MBTU/YR
	0.69	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	1,164.57	MBTU/YR
	1,164.57	MBTU/YR		X	CORR FACTOR		1				
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	1,209.84	MBTU/YR
									=	1,276,379.52	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	2,374.41	MBTU / YR	X	6.6	\$ /MBTU	=	15,671.11	\$ /YR
ECO - 1 =	1,164.57	MBTU / YR	X	4.62	\$ /MBTU	=	5,380.32	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								10,290.79
								\$ /YR



LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 486ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

STUDY: 486ECO1

LCCID 1.080

1. INVESTMENT

A. CONSTRUCTION COST	\$	147146.	
B. SIOH	\$	3757.	
C. DESIGN COST	\$	7357.	
D. TOTAL COST (1A+1B+1C)	\$	158261.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$	158261.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	5042.	\$ 33277.	17.56	\$ 584338.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-2473.	\$ -11425.	20.96	\$ -239464.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		2569.	\$ 21852.		\$ 344875.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 790.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 11645.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) COST(-) (4)
1. REPAIR	\$ 8040.	5	.86	6915.
2. REPAIR2	\$ 8040.	15	.63	5065.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 43514.	3	.91	39598.
d. TOTAL	\$ 61413.			52905.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 64550.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 25713.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.16 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 409424.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.59  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 8.12 %

```

=====
Estimate:      BLDG 486A           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1554510245	HTG INFA-RD UNT GAS ELEC IGN						
	(See Attached for Breakdown						
	Unit values	0.00	0.00	0.00	0.00	1.00 LS	
	Totals	0.00	\$0	\$0	\$0	\$49,240	\$49,240
U15 MECHANICAL		0	\$0	\$0	\$0	\$49,240	\$49,240

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	253	\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%					\$5,674
BOND	0.00%					\$0
PROFIT	10.00%					\$5,674
JOB TOTAL						\$68,093

```

=====
Estimate:      BLDG 486A           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      253      $0    $6,066    $1,438      $0    $7,504
U15 MECHANICAL      0      $0      $0      $0    $49,240    $49,240
TOTAL              253      $0    $6,066    $1,438    $49,240    $56,744
SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP          0.00%      $0
TOTAL BEFORE CONTINGENC      $0    $6,066    $1,438    $49,240    $56,744
CONTINGENCY        10.00%      $5,674
BOND                0.00%      $0
PROFIT              10.00%      $5,674
JOB TOTAL                                     $68,093

```

```
=====
Estimate:      BLDG 486A           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	925.00 L.F.	
Totals	410.70	\$3,857	\$9,530	\$0	0.00	14.47
					\$0	\$13,387
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	795.00 L.F.	
Totals	100.97	\$1,304	\$2,286	\$0	0.00	4.52
					\$0	\$3,590
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	129.00 Ea.	
Totals	64.50	\$5,133	\$491	\$0	0.00	43.59
					\$0	\$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	3.00 Ea.	
Totals	9.00	\$2,215	\$360	\$0	0.00	858.50
					\$0	\$2,575
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	18.00 Ea.	
Totals	18.00	\$15,480	\$793	\$0	0.00	904.06
					\$0	\$16,273
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	3.00 Ea.	
Totals	3.00	\$225	\$83	\$0	0.00	102.55
					\$0	\$308
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757

=====

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1631200100	HEATING SYSTEM POWER / CONTROL PANEL						
						3.00 Ea.	
Unit values		2.96	330.76	70.58	0.00	0.00	401.34
Totals		8.89	\$992	\$212	\$0	\$0	\$1,204
U16 ELECTRICAL		9	\$992	\$212	\$0	\$0	\$1,204

=====



=====

Line #	Description					
		Manhours	Matl	Labor	Equipment	Sub
						Total
ESTIMATE TOTAL		754	\$31,255	\$17,985	\$0	\$0
						\$49,240
SALES TAX	0.00%		\$0			
MATL MARKUP	0.00%		\$0			
LABOR MARKUP	0.00%			\$0		
EQUIPT MARKUP	0.00%				\$0	
SUB MARKUP	0.00%					\$0
TOTAL BEFORE CONTINGENC			\$31,255	\$17,985	\$0	\$0
CONTINGENCY	0.00%					\$49,240
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

```

=====
Estimate:      BLDG 486A           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      138    $2,049    $4,230          $0    $6,279
U15 MECHANICAL     607    $28,214   $13,543          $0   $41,757
U16 ELECTRICAL        9      $992      $212          $0    $1,204
TOTAL                754    $31,255   $17,985          $0   $49,240

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0

TOTAL BEFORE CONTINGENC $31,255   $17,985          $0   $49,240
CONTINGENCY          0.00%          $0
BOND                 0.00%          $0
PROFIT               0.00%          $0

JOB TOTAL                                     $49,240

```

```
=====
Estimate:      BLDG 486B           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					925.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		137.83	\$2,049	\$4,230	\$0	\$0	\$6,279
A09 ELECTRICAL		138	\$2,049	\$4,230	\$0	\$0	\$6,279

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	925.00 L.F.	
Totals	410.70	\$3,857	\$9,530	\$0	0.00	14.47
					\$0	\$13,387
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	795.00 L.F.	
Totals	100.97	\$1,304	\$2,286	\$0	0.00	4.52
					\$0	\$3,590
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	129.00 Ea.	
Totals	64.50	\$5,133	\$491	\$0	0.00	43.59
					\$0	\$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	3.00 Ea.	
Totals	9.00	\$2,215	\$360	\$0	0.00	858.50
					\$0	\$2,575
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	18.00 Ea.	
Totals	18.00	\$15,480	\$793	\$0	0.00	904.06
					\$0	\$16,273
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	3.00 Ea.	
Totals	3.00	\$225	\$83	\$0	0.00	102.55
					\$0	\$308
U15 MECHANICAL	607	\$28,214	\$13,543	\$0	\$0	\$41,757

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      3.00 Ea.
Totals           8.89      $992      $212       $0      $0      401.34
                                     $0      $1,204

U16 ELECTRICAL      9      $992      $212       $0       $0      $1,204
```

```
=====
Line #      Description
-----
              Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	754	\$31,255	\$17,985	\$0	\$0	\$49,240
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$31,255	\$17,985	\$0	\$0	\$49,240
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$49,240

```

=====
Estimate:      BLDG 486B           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx: Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      138    $2,049    $4,230          $0    $0    $6,279
U15 MECHANICAL      607   $28,214   $13,543          $0    $0   $41,757
U16 ELECTRICAL        9    $992     $212          $0    $0    $1,204
TOTAL                754   $31,255   $17,985          $0    $0   $49,240

SALES TAX            0.00%          $0
MATL MARKUP          0.00%          $0
LABOR MARKUP         0.00%          $0
EQUIPT MARKUP        0.00%          $0
SUB MARKUP           0.00%          $0

TOTAL BEFORE CONTINGENC $31,255   $17,985          $0    $0   $49,240
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $49,240

```

```

=====
Estimate:      BLDG 486B           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					900.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		135.00	\$0	\$2,840	\$1,157	\$0	\$3,997
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					1.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		21.82	\$0	\$571	\$0	\$0	\$571
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					900.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		63.90	\$0	\$1,776	\$213	\$0	\$1,989
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
U02 SITEWORK		253	\$0	\$6,066	\$1,438	\$0	\$7,504



```
=====
Line #      Description
-----
              Manhours  Matl    Labor  Equipment  Sub      Total
=====
1554510245   HTG INFA-RD UNT GAS ELEC IGN  (See Attached for Breakdown)
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  49240.00  49240.00
Totals           0.00      $0      $0      $0    $49,240  $49,240

U15 MECHANICAL      0      $0      $0      $0    $49,240  $49,240
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	253	\$0	\$6,066	\$1,438	\$49,240	\$56,744
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$6,066	\$1,438	\$49,240	\$56,744
CONTINGENCY	10.00%					\$5,674
BOND	0.00%					\$0
PROFIT	10.00%					\$5,674
JOB TOTAL						\$68,093

```

=====
Estimate:      BLDG 486B           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    *****          City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      253      $0    $6,066    $1,438      $0    $7,504
U15 MECHANICAL      0      $0      $0      $0    $49,240    $49,240
TOTAL              253      $0    $6,066    $1,438    $49,240    $56,744

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC      $0    $6,066    $1,438    $49,240    $56,744
CONTINGENCY        10.00%      $5,674
BOND               0.00%      $0
PROFIT             10.00%      $5,674
JOB TOTAL                                $68,093

```

```

=====
Estimate:      BLDG 486HB          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    2160.00           City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					200.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		30.00	\$0	\$631	\$257	\$0	\$888
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.75 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		10.91	\$0	\$285	\$0	\$0	\$285
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					20.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		4.00	\$0	\$111	\$14	\$0	\$125
U02 SITEWORK		60	\$0	\$1,422	\$318	\$0	\$1,740

```
=====
Line #      Description
-----
           Manhours   Matl     Labor   Equipment   Sub       Total
=====
```

1554510245      HTG INFA-RD UNT GAS ELEC IGN      (See Attached for Breakdown)

Unit values            0.00            0.00            0.00            0.00      7393.00      7393.00

Totals                0.00            \$0            \$0            \$0      \$7,393      \$7,393

U15 MECHANICAL            0            \$0            \$0            \$0      \$7,393      \$7,393

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment    Sub    Total
=====
```

ESTIMATE TOTAL	60	\$0	\$1,422	\$318	\$7,393	\$9,133
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$0	\$1,422	\$318	\$7,393	\$9,133
CONTINGENCY	10.00%					\$913
BOND	0.00%					\$0
PROFIT	10.00%					\$913
JOB TOTAL						\$10,960

```

=====
Estimate:      BLDG 486HB          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:      LIMITED EEAP (GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  2160.00          City indx: Louisville, KY
=====

```

## SUMMARY

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-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK          60         $0     $1,422     $318         $0     $1,740
U15 MECHANICAL         0         $0         $0         $0     $7,393     $7,393
TOTAL                  60         $0     $1,422     $318     $7,393     $9,133

SALES TAX              0.00%         $0
MATL MARKUP            0.00%         $0
LABOR MARKUP           0.00%         $0
EQUIPT MARKUP          0.00%         $0
SUB MARKUP             0.00%         $0

TOTAL BEFORE CONTINGENC      $0     $1,422     $318     $7,393     $9,133
CONTINGENCY                10.00%         $0
BOND                       0.00%         $0
PROFIT                     10.00%         $0
JOB TOTAL                                     $10,960

```

18-Oct-94

## MeansData for Lotus

Page 1

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=====
Estimate:      BLDG 486HB      Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY   Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====
```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	120.00 L.F.	
Totals		17.88	\$266	\$549	\$0	0.00 \$0	6.79 \$815
A09 ELECTRICAL		18	\$266	\$549	\$0	\$0	\$815



Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					120.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00		14.47
Totals	53.28	\$500	\$1,236	\$0	\$0		\$1,736
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					90.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00		4.52
Totals	11.43	\$148	\$259	\$0	\$0		\$407
1519010320	ALUMINUM REFLECTORS W/HANGERS					29.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00		43.59
Totals	14.50	\$1,154	\$110	\$0	\$0		\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00		858.50
Totals	3.00	\$738	\$120	\$0	\$0		\$858
1552301020	CRV-100 GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					2.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00		904.06
Totals	2.00	\$1,720	\$88	\$0	\$0		\$1,808
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					1.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00		102.55
Totals	1.00	\$75	\$28	\$0	\$0		\$103
U15 MECHANICAL		86	\$4,335	\$1,841	\$0	\$0	\$6,176

```
=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
```

1631200100 HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34

U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
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```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

ESTIMATE TOTAL      107    $4,932    $2,461        $0        $0    $7,393

SALES TAX            0.00%        $0
MATL MARKUP          0.00%        $0
LABOR MARKUP         0.00%        $0
EQUIPT MARKUP        0.00%        $0
SUB MARKUP           0.00%        $0

TOTAL BEFORE CONTINGENC $4,932    $2,461        $0        $0    $7,393
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $7,393
```

```

=====
Estimate:      BLDG 486HB           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

-----  
SUMMARY  
-----

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	18	\$266	\$549	\$0	\$0	\$815
U15 MECHANICAL	86	\$4,335	\$1,841	\$0	\$0	\$6,176
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	107	\$4,932	\$2,461	\$0	\$0	\$7,393
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$4,932	\$2,461	\$0	\$0	\$7,393
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$7,393

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 486A		BUILDING HEATING TEMPERATURE SETPOINT: 66 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F					
		TEMPERATURE DIFFERENCE 65 F					
INFILTRATION LOSSES =		1	AIR CHGS X	248400	VOL (CU FT) X 65	F TEMP DIFF X 0.019	= 0.31 MBTU / HR
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER X	65	F TEMP DIFF X 0.81	= 0.04	MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =		16215	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.11 MBTU / HR
FACE BRICK/BLK WALL =		3125	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.03 MBTU / HR
8" CINDER BLOCK WALL =		3527	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.09 MBTU / HR
CORR MTL PNL WALL =			AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
CLR SGL PANE WINDOWS =		1386	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.11 MBTU / HR
METAL ROLL UP DOORS =		1176	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR
MTL OVERHEAD DOORS =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =		2310	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.09 MBTU / HR
LG WOOD SLIDING DOOR =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL PERSONNEL DR =			AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =		175	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X 65	F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR
TOTAL BASELINE HEAT LOSSES							= 0.82 MBTU / HR
							= 869.70 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		486A	BUILDING HEATING TEMPERATURE SETPOINT:		55 F	PAGE 2 OF 3	
			OUTSIDE DESIGN TEMPERATURE		1 F		
			TEMPERATURE DIFFERENCE		54 F		
INFILTRATION LOSSES =	1	AIR CHGS	X	248400	VOL (CU FT)	X	54 F TEMP DIFF X 0.019 = 0.25 MBTU / HR
FLOOR LOSSES =	780	LINEAR FEET OF PERIMETER	X	54 F TEMP DIFF	X	0.81	= 0.03 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
FACE BRICK/BLK WALL =	3125	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
8" CINDER BLOCK WALL =	3527	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1386	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
METAL ROLL UP DOORS =	1176	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
MTL OVERHEAD DOORS =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	2310	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
LG WOOD SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =	0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =	175	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
TOTAL ECO HEAT LOSSES					= 0.68 MBTU / HR		
					= 722.52 MJ/HR		

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

SYSTEM EFFICIENCY	BASELINE	ECO - 1	BUILDING NUMBER	486A	GLOSSARY OF TERMS
OUTSIDE DESIGN TEMP (F)	60%	90%			1 MBTU = 1055 MJ
HTG TEMP SETPOINT (F)	1	1			0.019=CONSTANT
HEATING DEGREE DAYS	66	55			.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
TOTAL HEAT LOSSES	4616	3396			CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
(MBTU / HR)	0.82	0.68			65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$6.60	\$6.60			
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62			
\$ /MBTU -PPG	\$10.84	\$10.84			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.82	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	2,341.70	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	2,341.70	MBTU/YR							=		
	0.68	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,148.53	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,148.53	MBTU/YR							=	1,148.53	MBTU/YR
									=	1,193.17	MBTU/YR
									=	1,258,794.23	MJ/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS =											

## ANNUAL HEATING ENERGY COST

BASELINE =	2,341.70	MBTU / YR	X	6.6	\$ /MBTU	=	15,455.20	\$ /YR
ECO - 1 =	1,148.53	MBTU / YR	X	4.62	\$ /MBTU	=	5,306.20	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS = 10,149.01 \$ /YR								

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 486B		BUILDING HEATING TEMPERATURE SETPOINT: 66 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F			
		TEMPERATURE DIFFERENCE 65 F			
INFILTRATION LOSSES =	1	AIR CHGS X	248400	VOL (CU FT) X	65 F TEMP DIFF X 0.019 = 0.31 MBTU / HR
FLOOR LOSSES =	780	LINEAR FEET OF PERIMETER X	65	F TEMP DIFF X	0.81 = 0.04 MBTU / HR
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	16215	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.11 MBTU / HR
FACE BRICK/BLK WALL =	3125	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
8" CINDER BLOCK WALL =	5610	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.14 MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	347	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
METAL ROLL UP DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	2366	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.09 MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WD/ GLAZED PERSONNEL =	200	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
TOTAL BASELINE HEAT LOSSES				= 0.75 MBTU / HR	
				= 795.35 MJ/HR	



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		486B	BUILDING HEATING TEMPERATURE SETPOINT:				55 F		PAGE 2 OF 3			
			OUTSIDE DESIGN TEMPERATURE				1 F					
			TEMPERATURE DIFFERENCE				54 F					
INFILTRATION LOSSES =		1	AIR CHGS	X	248400	VOL (CU FT)	X	54 F TEMP DIFF	X 0.019 =	0.25	MBTU / HR	
FLOOR LOSSES =		780	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.03	MBTU / HR	
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =		16215	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.09	MBTU / HR
FACE BRICK/BLK WALL =		3125	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.02	MBTU / HR
8" CINDER BLOCK WALL =		5610	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.12	MBTU / HR
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR
CLR SGL PANE WINDOWS =		347	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.02	MBTU / HR
METAL ROLL UP DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =		2366	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.07	MBTU / HR
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR
METAL PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.00	MBTU / HR
WD/ GLAZED PERSONNEL=		200	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F	TEMPERATURE DIFFERENCE	= 0.01	MBTU / HR
TOTAL ECO HEAT LOSSES										=	0.63	MBTU / HR
										=	660.75	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	486B	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	ECO - 1		
OUTSIDE DESIGN TEMP (F)	60%	90%	1 MBTU = 1055 MJ
HTG TEMP SETPOINT (F)	1	55	0.019=CONSTANT
HEATING DEGREE DAYS	66	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
TOTAL HEAT LOSSES (MBTU / HR)	4616		CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
\$ /MBTU -FUEL OIL	0.75	0.63	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -NATURAL GAS	\$6.60	\$6.60	
\$ /MBTU -PPG	\$4.62	\$4.62	
	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	0.75	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY			
	0.6	SYS EFF	X	65	TEMP DIFFERENCE				=	2,141.51	MBTU/YR
	2,141.51	MBTU/YR	X		CORR FACTOR		1		=	2,141.51	MBTU/YR
ECO - 1 =	0.63	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	1,050.34	MBTU/YR
	1,050.34	MBTU/YR	X		CORR FACTOR		1		=	1,050.34	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	1,091.17	MBTU/YR
									=	1,151,181.12	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	2,141.51	MBTU / YR	X	6.6	\$ /MBTU		=	14,133.95	\$ /YR
ECO - 1 =	1,050.34	MBTU / YR	X	4.62	\$ /MBTU		=	4,852.58	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS							=	9,281.38	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 486HB		BUILDING HEATING TEMPERATURE SETPOINT: 66 F		PAGE 1 OF 3				
		OUTSIDE DESIGN TEMPERATURE		1 F				
		TEMPERATURE DIFFERENCE		65 F				
INFILTRATION LOSSES =	1	AIR CHGS X	69120	VOL (CU FT) X	65 F TEMP DIFF X 0.019 =	0.09	MBTU / HR	
FLOOR LOSSES =	108	LINEAR FEET OF PERIMETER X	65	F TEMP DIFF X	0.81 =	0.01	MBTU / HR	
SURFACE HEAT LOSSES								
FLAT BUILT UP ROOF =	2160	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
FACE BRICK/BLK WALL =	192	AREA (SF) X	0.14	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =		AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CORR MTL PNL WALL =	3008	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL ROLL UP DOORS =	1536	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG WOOD SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =		AREA (SF) X	0.54	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WD/ GLAZED PERSONNEL =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	65 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TOTAL BASELINE HEAT LOSSES						=	0.20	MBTU / HR
						=	207.51	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		486HB	BUILDING HEATING TEMPERATURE SETPOINT:				55 F		PAGE 2 OF 3				
			OUTSIDE DESIGN TEMPERATURE				1 F						
			TEMPERATURE DIFFERENCE				54 F						
INFILTRATION LOSSES =		1	AIR CHGS	X	69120	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.07	MBTU / HR
FLOOR LOSSES =		108	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.00	MBTU / HR		
SURFACE HEAT LOSSES													
FLAT BUILT UP ROOF =		2160	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
FACE BRICK/BLK WALL =		192	AREA (SF)	X	0.14	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =		0	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CORR MTL PNL WALL =		3008	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
CLR SGL PANE WINDOWS =		0	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL ROLL UP DOORS =		1536	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR		
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD GLAZED O'HEAD DR =		0	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=		0	AREA (SF)	X	0.54	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WD/ GLAZED PERSONNEL=		0	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES											=	0.16	MBTU / HR
											=	172.39	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	486HB	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	ECO - 1	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	90%	0.019=CONSTANT
HTG TEMP SETPOINT (F)	66	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	0.20	0.16	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)			
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.20	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	558.71	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
ECO - 1 =	558.71	MBTU/YR	X	CORR FACTOR	1				=		558.71
	0.16	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	274.03	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	274.03	MBTU/YR	X	CORR FACTOR	1				=		274.03
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	284.68	MBTU/YR
									=	300,339.84	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	558.71	MBTU / YR	X	4.62	\$ /MBTU	=	2,581.26	\$ /YR
ECO - 1 =	274.03	MBTU / YR	X	4.62	\$ /MBTU	=	1,266.02	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								1,315.23 \$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: PRJT2  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: PRJT2      FEMP PROJECT 2 - INFRARED HEAT      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	800972.	
B. SIOH	\$	40049.	
C. DESIGN COST	\$	40049.	
D. TOTAL COST (1A+1B+1C)	\$	881069.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		881069.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	11131.	\$ 73462.	17.56	\$ 1289994.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	1683.	\$ 7775.	20.96	\$ 162969.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		12814.	\$ 81237.		\$ 1452963.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 8910.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 131333.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTOR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPAIR	\$ 88710.	5	.86	76291.
2. REPAIR2	\$ 88710.	15	.63	55887.
3. REPAIR3	\$ 17391.	7	.81	14087.
4. REPAIR4	\$ 17391.	14	.65	11304.
5. ENVIR	\$ 81345.	3	.91	74024.
d. TOTAL	\$ 293547.			231593.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 362926.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 104825.

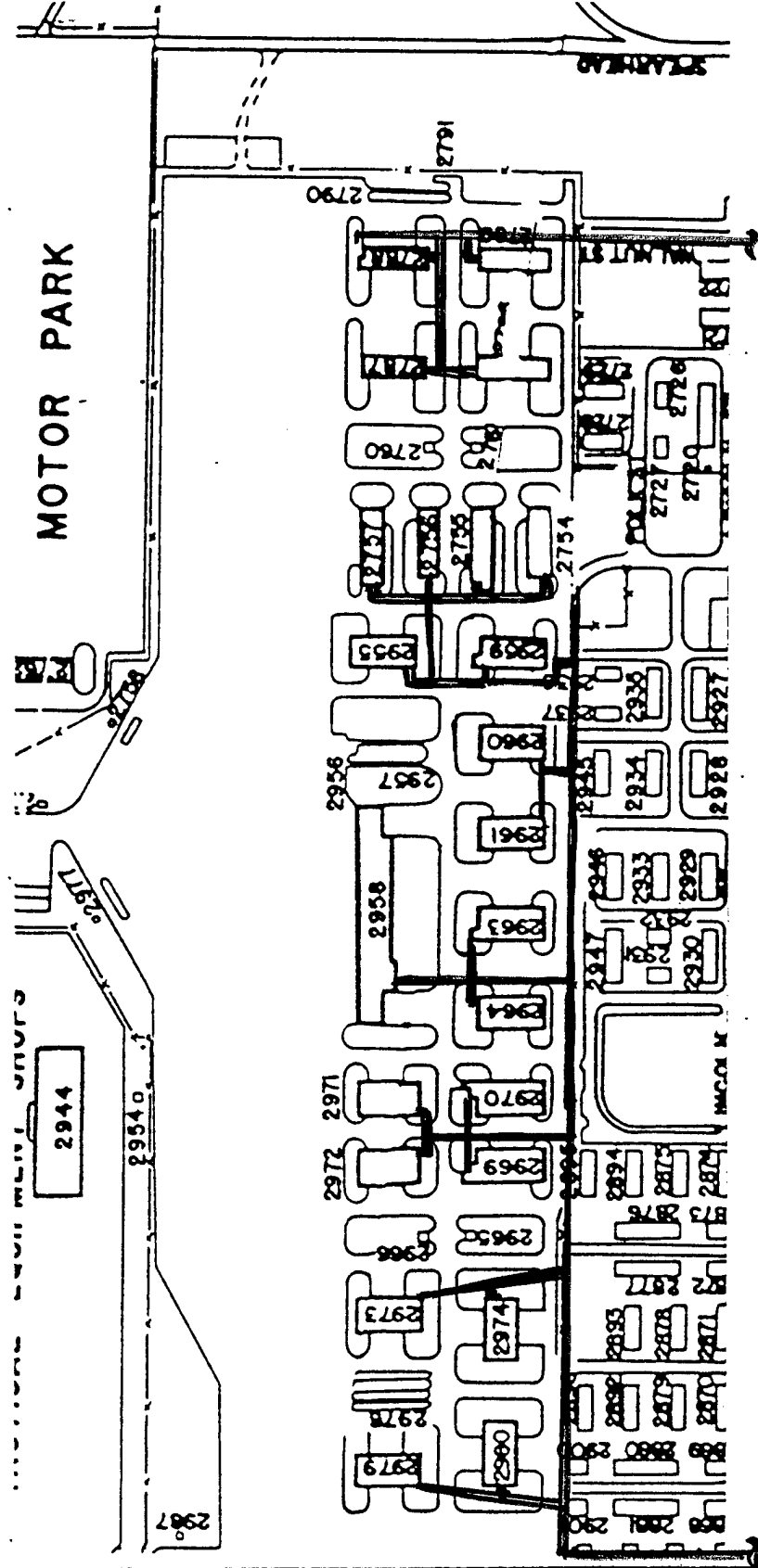
5. SIMPLE PAYBACK PERIOD (1G/4) 8.41 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 1815889.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  2.06  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.90 %

MOTOR PARK



**ST. JOHN TANK MOTOR PARK**

— EXISTING NG MAIN  
 - - - PROPOSED NG MAIN

**SYSTEMS***corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION  
 KNOXVILLE, TENNESSEE 37919

**FT. KNOX GLASS STUDY**

**NEW NATURAL GAS LINES REQUIRED**

DRAWN BY B. YATES

JOB NO.

94013.02

SHEET NO.

CHECKED BY J. HOLLENSBE

DATE

10-07-94

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2754ECO1  
LCCID 1.080

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 2754ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	60379.	
B. SIOH	\$	3019.	
C. DESIGN COST	\$	3019.	
D. TOTAL COST (1A+1B+1C)	\$	66417.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		66417.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	1822.	\$ 12025.	17.56	\$ 211151.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-894.	\$ -4128.	20.96	\$ -86530.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		928.	\$ 7896.		\$ 124621.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A) 14.74

(2) DISCOUNTED SAVING/COST (3A X 3A1) \$ 990.

\$ 14593.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 4436.	5	.86	3815.
2. REPAIR2	\$ 4436.	15	.63	2794.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 19958.	3	.91	18162.
d. TOTAL	\$ 30647.			26098.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 40691.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 10419.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.37 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 165312.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.49  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.91 %



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Estimate:      BLDG 2754          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP (GLASSBid Date:
Location:       FORT KNOX, KY    Job #:      94013.02
Sq. footage:   5000.00          City indx: Louisville, KY
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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00		0.47
Totals	2.10	\$0	\$50	\$50	\$0		\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	
Unit values	0.05	17.52	1.07	1.02	0.00		19.61
Totals	1.54	\$552	\$34	\$32	\$0		\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.	

17-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
					4.50 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
					1.00 Ea.	
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
					240.00 L.F.	
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIA					
					50.00 L.F.	
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub    Total
=====
U02 SITEWORK      167    $1,100    $3,861    $1,882        $0    $6,843
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals           0.00      $0        $0        $0    17915.00  17915.00
                                           $17,915    $17,915
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53      226.00      12.10      0.00      1.00 Ea.
Totals           0.53      $226      $12        $0      0.00    238.10
                                           $0        $238
U15 MECHANICAL      1      $226      $12        $0    $17,915    $18,153

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL		168	\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
SALES TAX	0.00%		\$0				
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
CONTINGENCY	10.00%						\$2,500
BOND	0.00%						\$0
PROFIT	10.00%						\$2,500
JOB TOTAL							\$29,995

```

=====
Estimate:      BLDG 2754          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED BEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5000.00           City indx:Louisville, KY
=====

```

=====

SUMMARY

=====

	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	167	\$1,100	\$3,861	\$1,882	\$0	\$6,843
U15 MECHANICAL	1	\$226	\$12	\$0	\$17,915	\$18,153
TOTAL	168	\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
CONTINGENCY	10.00%					\$2,500
BOND	0.00%					\$0
PROFIT	10.00%					\$2,500
JOB TOTAL						\$29,995

```

=====
Estimate:      BLDG 2754           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					305.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		45.45	\$676	\$1,395	\$0	\$0	\$2,071
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					15.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.24	\$33	\$69	\$0	\$0	\$102
A09 ELECTRICAL		48	\$709	\$1,464	\$0	\$0	\$2,173

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					305.00 L.F.	
Unit values		0.44	4.17	10.30	0.00	0.00	14.47
Totals		135.42	\$1,272	\$3,142	\$0	\$0	\$4,414
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					320.00 L.F.	
Unit values		0.13	1.64	2.88	0.00	0.00	4.52
Totals		40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					42.00 Ea.	
Unit values		0.50	39.79	3.80	0.00	0.00	43.59
Totals		21.00	\$1,671	\$160	\$0	\$0	\$1,831
1524105040	VACUUM PUMP AND VENT PIPING					1.00 Ea.	
Unit values		3.00	738.35	120.15	0.00	0.00	858.50
Totals		3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					6.00 Ea.	
Unit values		1.00	860.00	44.06	0.00	0.00	904.06
Totals		6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					1.00 Ea.	
Unit values		4.00	935.00	81.70	0.00	0.00	1016.70
Totals		4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					1.00 Ea.	
Unit values		1.60	70.00	76.50	0.00	0.00	146.50
Totals		1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					2.00 Ea.	
Unit values		1.00	75.00	27.55	0.00	0.00	102.55
Totals		2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL		214	\$10,521	\$4,819	\$0	\$0	\$15,340

18-Oct-94

## MeansData for Lotus

Page 3

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34
					\$0	\$402

U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
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18-Oct-94

MeansData for Lotus

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL		265	\$11,561	\$6,354	\$0	\$0	\$17,915
SALES TAX	0.00%		\$0		\$0		
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$11,561	\$6,354		\$0	\$17,915
CONTINGENCY	0.00%				\$0		
BOND	0.00%					\$0	
PROFIT	0.00%						\$0
JOB TOTAL							\$17,915

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## MeansData for Lotus

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=====
Estimate:      BLDG 2754           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      48      $709      $1,464      $0      $0      $2,173
U15 MECHANICAL    214    $10,521    $4,819      $0      $0      $15,340
U16 ELECTRICAL      3      $331      $71        $0      $0      $402
TOTAL              265    $11,561    $6,354      $0      $0      $17,915

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $11,561    $6,354      $0      $0      $17,915
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL

$17,915

```

```

=====
Estimate:      BLDG 2755          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5000.00           City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values	12.00	0.00	323.82	0.00	0.00		323.82
Totals	12.00	\$0	\$324	\$0	\$0		\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00		0.47
Totals	2.10	\$0	\$50	\$50	\$0		\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	

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MeansData for Lotus

Page 2

Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					4.50 C.Y.
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					1.00 Ea.
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-PSI 2" DIAM COIL SDR 11					240.00 L.F.
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					50.00 L.F.
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
      Manhours   Matl     Labor   Equipment   Sub     Total
=====
U02 SITEWORK      179     $1,100     $4,185     $1,882         $0     $7,167
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00         0.00         0.00         0.00     1.00 LS.
Totals           0.00         $0           $0           $0     $17,915     $17,915
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53     226.00     12.10         0.00     1.00 Ea.
Totals           0.53     $226         $12           $0     0.00     238.10
                        $0           $0           $0     $238
U15 MECHANICAL      1         $226         $12           $0     $17,915     $18,153

```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	180	\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
CONTINGENCY	10.00%					\$2,532
BOND	0.00%					\$0
PROFIT	10.00%					\$2,532
JOB TOTAL						\$30,384

```

=====
Estimate:      BLDG 2755          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5000.00           City indx:Louisville, KY
=====

```

## SUMMARY

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-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      179     $1,100   $4,185   $1,882       $0     $7,167
U15 MECHANICAL      1       $226     $12      $0     $17,915   $18,153
TOTAL              180     $1,326   $4,197   $1,882   $17,915   $25,320

SALES TAX          0.00%       $0
MATL MARKUP        0.00%       $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326   $4,197   $1,882   $17,915   $25,320
CONTINGENCY        10.00%      $2,532
BOND               0.00%       $0
PROFIT            10.00%      $2,532
JOB TOTAL                                     $30,384

```

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=====
Estimate:      BLDG 2755           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					305.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		45.45	\$676	\$1,395	\$0	\$0	\$2,071
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					15.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.24	\$33	\$69	\$0	\$0	\$102
A09 ELECTRICAL		48	\$709	\$1,464	\$0	\$0	\$2,173



Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	305.00 L.F.	
Totals	135.42	\$1,272	\$3,142	\$0	0.00	14.47
					\$0	\$4,414
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	320.00 L.F.	
Totals	40.64	\$525	\$920	\$0	0.00	4.52
					\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	42.00 Ea.	
Totals	21.00	\$1,671	\$160	\$0	0.00	43.59
					\$0	\$1,831
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	
Totals	3.00	\$738	\$120	\$0	0.00	858.50
					\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	
Totals	6.00	\$5,160	\$264	\$0	0.00	904.06
					\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
Unit values	4.00	935.00	81.70	0.00	1.00 Ea.	
Totals	4.00	\$935	\$82	\$0	0.00	1016.70
					\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	1.00 Ea.	
Totals	1.60	\$70	\$76	\$0	0.00	146.50
					\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	2.00 Ea.	
Totals	2.00	\$150	\$55	\$0	0.00	102.55
					\$0	\$205
U15 MECHANICAL	214	\$10,521	\$4,819	\$0	\$0	\$15,340

```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub    Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58     0.00    1.00 Ea.
Totals           2.96    $331      $71       $0      0.00    401.34
                                $0      $0      $0      $402

U16 ELECTRICAL      3      $331      $71       $0       $0      $402
```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	265	\$11,561	\$6,354	\$0	\$0	\$17,915
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,561	\$6,354	\$0	\$0	\$17,915
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,915

```

=====
Estimate:      BLDG 2755           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      48      $709      $1,464      $0      $0      $2,173
U15 MECHANICAL     214     $10,521     $4,819      $0      $0     $15,340
U16 ELECTRICAL       3       $331       $71        $0      $0       $402
TOTAL              265     $11,561     $6,354      $0      $0     $17,915

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $11,561     $6,354      $0      $0     $17,915
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $17,915

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2754		BUILDING HEATING TEMPERATURE SETPOINT: 60 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE				1 F	
		TEMPERATURE DIFFERENCE				59 F	
INFILTRATION LOSSES =		1	AIR CHGS	X	76000	VOL (CU FT)	X 59 F TEMP DIFF X 0.019 = 0.09 MBTU / HR
FLOOR LOSSES =		330	LINEAR FEET OF PERIMETER	X	59	F TEMP DIFF	X 0.81 = 0.02 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.03 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.06 MBTU / HR
CORR MTL PNL WALL =		AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.08 MBTU / HR
TINTED DBL PANE WIN'W =		AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL ROLL UP DOORS =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL GLAZED O'HEAD DR =	1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES							= 0.29 MBTU / HR
							= 307.10 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2754		BUILDING HEATING TEMPERATURE SETPOINT: 55 F			
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		54 F	
INFILTRATION LOSSES =	1	AIR CHGS	X	76000	VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.08 MBTU / HR
FLOOR LOSSES =	330	LINEAR FEET OF PERIMETER	X	54 F TEMP DIFF	X 0.81 = 0.01 MBTU / HR
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.05 MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
TINTED DBL PANE WIN'W =	0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL ROLL UP DOORS =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =	1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL ECO HEAT LOSSES				= 0.27 MBTU / HR	
				= 281.07 MJ/HR	

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.29	0.27
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

**BUILDING NUMBER** 2754

## GLOSSARY OF TERMS

**1 MBTU = 1055 MJ**

0.019=CONSTANT

.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE

CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS

665 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

[illegible]

# ANNUAL HEATING ENERGY COST

BASELINE =	910.95	MBTU / YR X	6.6	\$ /MBTU	=	6,012.30	\$ /YR
ECO - 1 =	446.79	MBTU / YR X	4.62	\$ /MBTU	=	2,064.19	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS					=	3,948.11	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2755		BUILDING HEATING TEMPERATURE SETPOINT: 60 F					PAGE 1 OF 3							
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 59 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	76000	VOL (CU FT)	X	59	F TEMP DIFF	X	0.019	=	0.09	MBTU / HR
FLOOR LOSSES =		330	LINEAR FEET OF PERIMETER			X	59	F TEMP DIFF	X	0.81	=	0.02	MBTU / HR	
SURFACE HEAT LOSSES														
FLAT BUILT UP ROOF =		5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
FACE BRICK/BLK WALL =			AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =		2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =			AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =		1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.08	MBTU / HR		
TINTED DBL PANE WIN'W =			AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL ROLL UP DOORS =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL GLAZED O'HEAD DR =		1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR		
LG MTL SLIDING DOOR =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=		50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL BASELINE HEAT LOSSES										=	0.29	MBTU / HR		
										=	307.10	MJ/HR		



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2755		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3		
		OUTSIDE DESIGN TEMPERATURE 1 F							
		TEMPERATURE DIFFERENCE 54 F							
INFILTRATION LOSSES =		1	AIR CHGS	X	76000	VOL (CU FT)	X 54 F TEMP DIFF	X 0.019	= 0.08 MBTU / HR
FLOOR LOSSES =		330	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X 0.81	= 0.01 MBTU / HR	
SURFACE HEAT LOSSES									
FLAT BUILT UP ROOF =		5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.03 MBTU / HR	
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
8" CINDER BLOCK WALL =		2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.05 MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
CLR SGL PANE WINDOWS =		1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.07 MBTU / HR	
TINTED DBL PANE WIN"W =		0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
METAL ROLL UP DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
WOOD GLAZED O'HEAD DR =		1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR	
LG MTL SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
MTL/ GLAZED PERSONNEL=		50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X 54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
TOTAL ECO HEAT LOSSES								= 0.27 MBTU / HR	
								= 281.07 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASLINE	ECO - 1	BUILDING NUMBER	2755	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%			1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	1			0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	55			.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396			CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.29	0.27			65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$6.60	\$6.60			
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62			
\$ /MBTU -PPG	\$10.84	\$10.84			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	0.29	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY				
	0.6	SYS EFF	X	59	TEMP DIFFERENCE				=	910.95	MBTU/YR	
ECO - 1 =	910.95	MBTU/YR				X		CORR FACTOR		1		
	0.27	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			910.95	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	446.79	MBTU/YR	
	446.79	MBTU/YR				X		CORR FACTOR		1		
									=		446.79	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS												
									=		464.16	MBTU/YR
									=		489,689.25	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	910.95	MBTU / YR	X	6.6	\$ /MBTU		=	6,012.30	\$ /YR
ECO - 1 =	446.79	MBTU / YR	X	4.62	\$ /MBTU		=	2,064.19	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS									
							=	3,948.11	\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 2756ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: 2756ECO1      ECO-1 INFRARED HEAT      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	60379.	
B. SIOH	\$	3019.	
C. DESIGN COST	\$	3019.	
D. TOTAL COST (1A+1B+1C)	\$	66417.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		66417.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	1822.	\$ 12025.	17.56	\$ 211151.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-894.	\$ -4128.	20.96	\$ -86530.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		928.	\$ 7896.		\$ 124621.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 990.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 14593.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) / COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
1. REPAIR	\$ 4436.	5	.86	3815.
2. REPAIR2	\$ 4436.	15	.63	2794.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 19870.	3	.91	18082.
d. TOTAL	\$ 30559.			26018.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3Bd4) \$ 40610.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 10414.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.38 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 165231.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.49  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.91 %

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=====
Estimate:      BLDG 2756           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5000.00           City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.	

17-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
            Manhours   Matl      Labor    Equipment   Sub      Total
=====
U02 SITEWORK      167      $1,100    $3,861    $1,882        $0      $6,843
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00    17915.00    17915.00
Totals           0.00      $0        $0        $0      $17,915    $17,915
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53     226.00     12.10      0.00      0.00      238.10
Totals           0.53     $226      $12        $0        $0        $238
U15 MECHANICAL      1      $226      $12        $0      $17,915    $18,153

```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	168	\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$3,873	\$1,882	\$17,915	\$24,996
CONTINGENCY	10.00%					\$2,500
BOND	0.00%					\$0
PROFIT	10.00%					\$2,500
JOB TOTAL						\$29,995

```

=====
Estimate:      BLDG 2756           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  5000.00           City indx: Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      167    $1,100    $3,861    $1,882      $0    $6,843
U15 MECHANICAL      1      $226      $12      $0    $17,915    $18,153
TOTAL              168    $1,326    $3,873    $1,882    $17,915    $24,996

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326    $3,873    $1,882    $17,915    $24,996
CONTINGENCY        10.00%      $2,500
BOND               0.00%      $0
PROFIT            10.00%      $2,500
JOB TOTAL                                     $29,995

```



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=====
Estimate:      BLDG 2756           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					305.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		45.45	\$676	\$1,395	\$0	\$0	\$2,071
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					15.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.24	\$33	\$69	\$0	\$0	\$102
A09 ELECTRICAL		48	\$709	\$1,464	\$0	\$0	\$2,173

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 305.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	135.42	\$1,272	\$3,142	\$0	\$0	\$4,414
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM 320.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS 42.00 Ea.					
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	21.00	\$1,671	\$160	\$0	\$0	\$1,831
1524105040	VACUUM PUMP AND VENT PIPING 1.00 Ea.					
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER 6.00 Ea.					
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH 1.00 Ea.					
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE 1.00 Ea.					
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING 2.00 Ea.					
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	214	\$10,521	\$4,819	\$0	\$0	\$15,340

=====

Line #	Description						
		Manhours	Matl	Labor	Equipment	Sub	Total
1631200100	HEATING SYSTEM POWER / CONTROL PANEL						
						1.00 Ea.	
Unit values		2.96	330.76	70.58	0.00	0.00	401.34
Totals		2.96	\$331	\$71	\$0	\$0	\$402
U16 ELECTRICAL		3	\$331	\$71	\$0	\$0	\$402

=====

18-Oct-94

## MeansData for Lotus

Page 4

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	265	\$11,561	\$6,354	\$0	\$0	\$17,915
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,561	\$6,354	\$0	\$0	\$17,915
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,915

```

=====
Estimate:      BLDG 2756           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

-----  
SUMMARY  
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	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	48	\$709	\$1,464	\$0	\$0	\$2,173
U15 MECHANICAL	214	\$10,521	\$4,819	\$0	\$0	\$15,340
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	265	\$11,561	\$6,354	\$0	\$0	\$17,915
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,561	\$6,354	\$0	\$0	\$17,915
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,915

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=====
Estimate:      BLDG 2757          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    5000.00          City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	

Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      179    $1,100    $4,185    $1,882      $0    $7,167
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  17915.00  17915.00
Totals            0.00      $0        $0        $0    $17,915  $17,915
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00    238.10
Totals            0.53    $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $17,915  $18,153
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=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	180	\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
CONTINGENCY	10.00%					\$2,532
BOND	0.00%					\$0
PROFIT	10.00%					\$2,532
JOB TOTAL						\$30,384

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Estimate:      BLDG 2757          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   5000.00           City indx:Louisville, KY
=====

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SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	179	\$1,100	\$4,185	\$1,882	\$0	\$7,167
U15 MECHANICAL	1	\$226	\$12	\$0	\$17,915	\$18,153
TOTAL	180	\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,197	\$1,882	\$17,915	\$25,320
CONTINGENCY	10.00%					\$2,532
BOND	0.00%					\$0
PROFIT	10.00%					\$2,532
JOB TOTAL						\$30,384

```

=====
Estimate:      BLDG 2757          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					305.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		45.45	\$676	\$1,395	\$0	\$0	\$2,071
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					15.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.24	\$33	\$69	\$0	\$0	\$102
A09 ELECTRICAL		48	\$709	\$1,464	\$0	\$0	\$2,173

Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 305.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	135.42	\$1,272	\$3,142	\$0	\$0	\$4,414
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM 320.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS 42.00 Ea.					
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	21.00	\$1,671	\$160	\$0	\$0	\$1,831
1524105040	VACUUM PUMP AND VENT PIPING 1.00 Ea.					
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER 6.00 Ea.					
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH 1.00 Ea.					
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE 1.00 Ea.					
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING 2.00 Ea.					
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	214	\$10,521	\$4,819	\$0	\$0	\$15,340

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96      330.76      70.58      0.00      1.00 Ea.
Totals           2.96      $331        $71        $0        0.00      401.34
                                           $0        $0        $402

U16 ELECTRICAL      3      $331        $71        $0        $0        $402
```

=====

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL		265	\$11,561	\$6,354	\$0	\$0	\$17,915
SALES TAX	0.00%		\$0				
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$11,561	\$6,354	\$0	\$0	\$17,915
CONTINGENCY	0.00%						\$0
BOND	0.00%						\$0
PROFIT	0.00%						\$0
JOB TOTAL							\$17,915

```

=====
Estimate:      BLDG 2757          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      48      $709    $1,464      $0      $0    $2,173
U15 MECHANICAL     214    $10,521    $4,819      $0      $0   $15,340
U16 ELECTRICAL       3      $331      $71      $0      $0    $402
TOTAL              265    $11,561    $6,354      $0      $0   $17,915

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $11,561    $6,354      $0      $0   $17,915
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                     $17,915

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2756		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3			
		OUTSIDE DESIGN TEMPERATURE		1 F			
		TEMPERATURE DIFFERENCE		59 F			
INFILTRATION LOSSES =	1	AIR CHGS X	76000	VOL (CU FT) X	59 F TEMP DIFF X 0.019 =	0.09	MBTU / HR
FLOOR LOSSES =	330	LINEAR FEET OF PERIMETER X		59 F TEMP DIFF X 0.81 =	0.02	0.02	MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	5000	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.03
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
8" CINDER BLOCK WALL =	2535	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.06
CORR MTL PNL WALL =		AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
CLR SGL PANE WINDOWS =	1123	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.08
TINTED DBL PANE WIN'W =		AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
METAL ROLL UP DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
METAL GLAZED O'HEAD DR =	1372	AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.02
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
MTL/ GLAZED PERSONNEL=	50	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00
TOTAL BASELINE HEAT LOSSES						=	0.29
						=	307.10
							MBTU / HR
							MJ/HR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2756 BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
 OUTSIDE DESIGN TEMPERATURE 1 F  
 TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 76000 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.08 MBTU / HR  
 FLOOR LOSSES = 330 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.01 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	5000	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2535	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	1123	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
TINTED DBL PANE WIN"W =	0	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL ROLL UP DOORS =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =	1372	AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	50	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.27 MBTU / HR  
 = 281.07 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASLINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.29	0.27
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 2756

### GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	0.29	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY			
	0.6	SYS EFF	X	59	TEMP DIFFERENCE				=	910.95	MBTU/YR
	910.95	MBTU/YR		X	CORR FACTOR		1		=		910.95 MBTU/YR
ECO - 1 =	0.27	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	446.79	MBTU/YR
	446.79	MBTU/YR		X	CORR FACTOR		1		=		446.79 MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	464.16	MBTU/YR
									=	489,689.25	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	910.95	MBTU / YR	X	6.6	\$ /MBTU	=	6,012.30	\$ /YR
ECO - 1 =	446.79	MBTU / YR	X	4.62	\$ /MBTU	=	2,064.19	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								3,948.11 \$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2757		BUILDING HEATING TEMPERATURE SETPOINT: 60 F					PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE					1 F	
		TEMPERATURE DIFFERENCE					59 F	
INFILTRATION LOSSES =	1	AIR CHGS	X	76000	VOL (CU FT)	X	59 F TEMP DIFF	X 0.019 = 0.09 MBTU / HR
FLOOR LOSSES =	330	LINEAR FEET OF PERIMETER			X	59 F TEMP DIFF	X 0.81 = 0.02 MBTU / HR	
SURFACE HEAT LOSSES								
FLAT BUILT UP ROOF =	5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.03 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.06 MBTU / HR
CORR MTL PNL WALL =		AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.08 MBTU / HR
TINTED DBL PANE WIN'W =		AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL ROLL UP DOORS =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL GLAZED O'HEAD DR =	1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES								= 0.29 MBTU / HR
								= 307.10 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2757		BUILDING HEATING TEMPERATURE SETPOINT: 55 F OUTSIDE DESIGN TEMPERATURE 1 F TEMPERATURE DIFFERENCE 54 F										
INFILTRATION LOSSES =		1	AIR CHGS	X	76000	VOL (CU FT)	X	54 F TEMP DIFF	X 0.019	=	0.08	MBTU / HR
FLOOR LOSSES =		330	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.01	MBTU / HR	
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =		5000	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR	
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
8" CINDER BLOCK WALL =		2535	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR	
CORR MTL PNL WALL =		0	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
CLR SGL PANE WINDOWS =		1123	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR	
TINTED DBL PANE WIN"W =		0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL ROLL UP DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
WOOD GLAZED O'HEAD DR =		1372	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR	
LG MTL SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
MTL/ GLAZED PERSONNEL=		50	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES										=	0.27	MBTU / HR
										=	281.07	MJ/HR

# FT KNOX LIMITED EÉAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.29	0.27
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 2757

GLOSSARY OF TERMS

1 MBTU = 1055 MJ

0.019=CONSTANT

.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE

CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS

65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.29	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	910.95	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
	910.95	MBTU/YR	X		CORR FACTOR	1		910.95			
ECO - 1 =	0.27	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	446.79	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	446.79	MBTU/YR	X		CORR FACTOR	1		446.79			
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	464.16	MBTU/YR
									=	489,689.25	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	910.95	MBTU / YR	X	6.6	\$ /MBTU	=	6,012.30	\$ /YR
ECO - 1 =	446.79	MBTU / YR	X	4.62	\$ /MBTU	=	2,064.19	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								3,948.11 \$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2786ECO1  
LCCID 1.080

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 2786ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	110114.	
B. SIOH	\$	5506.	
C. DESIGN COST	\$	5506.	
D. TOTAL COST (1A+1B+1C)	\$	121125.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$	121125.	

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	1619.	\$ 7479.	20.96	\$ 156757.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1619.	\$ 7479.		\$ 156757.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 990.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 14593.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 15968.	5	.86	13732.
2. REPAIR2	\$ 15968.	15	.63	10060.
3. REPAIR3	\$ 3211.	7	.81	2601.
4. REPAIR4	\$ 3211.	14	.65	2087.

d. TOTAL      \$ 38358.      28481.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 43073.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 10387.

5. SIMPLE PAYBACK PERIOD (1G/4) 11.66 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 199830.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 1.65  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.71 %

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Estimate:      BLDG 2786           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:   4800.00           City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00		0.47
Totals	2.10	\$0	\$50	\$50	\$0		\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	
Unit values	0.05	17.52	1.07	1.02	0.00		19.61
Totals	1.54	\$552	\$34	\$32	\$0		\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.	

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253



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Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      167    $1,100    $3,861    $1,882        $0    $6,843
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values              0.00      0.00      0.00      0.00      1.00 LS.
Totals                  0.00      $0      $0      $0    $17,306    $17,306
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values          0.53    226.00    12.10      0.00      0.00 Ea.
Totals                0.53    $226      $12      $0      $0    $238
U15 MECHANICAL      1      $226      $12      $0    $17,306    $17,544

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=====
Line #      Description
-----
            Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	168	\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
CONTINGENCY	10.00%					\$2,439
BOND	0.00%					\$0
PROFIT	10.00%					\$2,439
JOB TOTAL						\$29,264

```

=====
Estimate:      BLDG 2786           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    4800.00           City indx:Louisville, KY
=====

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SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	167	\$1,100	\$3,861	\$1,882	\$0	\$6,843
U15 MECHANICAL	1	\$226	\$12	\$0	\$17,306	\$17,544
TOTAL	168	\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
CONTINGENCY	10.00%					\$2,439
BOND	0.00%					\$0
PROFIT	10.00%					\$2,439
JOB TOTAL						\$29,264

```

=====
Estimate:      BLDG 2786           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					20.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.98	\$44	\$91	\$0	\$0	\$135
A09 ELECTRICAL		48	\$709	\$1,463	\$0	\$0	\$2,172

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					275.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	122.10	\$1,147	\$2,833	\$0	\$0	\$3,980
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
					320.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					38.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	19.00	\$1,512	\$145	\$0	\$0	\$1,657
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
					1.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					1.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					2.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	199	\$10,237	\$4,495	\$0	\$0	\$14,732

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=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58     0.00      1.00 Ea.
Totals           2.96    $331      $71       $0      0.00      401.34
                                   $0      $0      $0      $402

U16 ELECTRICAL      3      $331      $71       $0       $0      $402
```

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	250	\$11,277	\$6,029	\$0	\$0	\$17,306
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,277	\$6,029	\$0	\$0	\$17,306
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,306

```

=====
Estimate:      BLDG 2786           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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## SUMMARY

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=====
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
A09 ELECTRICAL      48        $709    $1,463        $0        $0    $2,172
U15 MECHANICAL     199       $10,237  $4,495        $0        $0   $14,732
U16 ELECTRICAL       3        $331    $71          $0        $0    $402
TOTAL                250       $11,277  $6,029        $0        $0   $17,306

SALES TAX           0.00%        $0
MATL MARKUP         0.00%        $0
LABOR MARKUP        0.00%        $0
EQUIPT MARKUP       0.00%        $0
SUB MARKUP          0.00%        $0

TOTAL BEFORE CONTINGENC $11,277  $6,029        $0        $0   $17,306
CONTINGENCY          0.00%        $0
BOND                 0.00%        $0
PROFIT               0.00%        $0

JOB TOTAL                                $17,306
=====

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=====
Estimate:      BLDG 2787          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    4800.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00		0.47
Totals	2.10	\$0	\$50	\$50	\$0		\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.	
Unit values	0.05	17.52	1.07	1.02	0.00		19.61
Totals	1.54	\$552	\$34	\$32	\$0		\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.	

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      167    $1,100    $3,861    $1,882      $0    $6,843
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS. 17306.00
Totals            0.00      $0        $0        $0    $17,306  $17,306
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53      226.00     12.10      0.00      1.00 Ea. 238.10
Totals            0.53      $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $17,306  $17,544

```

```
=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	168	\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$3,873	\$1,882	\$17,306	\$24,387
CONTINGENCY	10.00%					\$2,439
BOND	0.00%					\$0
PROFIT	10.00%					\$2,439
JOB TOTAL						\$29,264

```

=====
Estimate:      BLDG 2787          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  4800.00           City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      167    $1,100    $3,861    $1,882         $0    $6,843
U15 MECHANICAL      1      $226      $12        $0    $17,306    $17,544
TOTAL              168    $1,326    $3,873    $1,882    $17,306    $24,387

SALES TAX          0.00%         $0
MATL MARKUP        0.00%         $0
LABOR MARKUP       0.00%         $0
EQUIPT MARKUP      0.00%         $0
SUB MARKUP         0.00%         $0

TOTAL BEFORE CONTINGENC $1,326    $3,873    $1,882    $17,306    $24,387
CONTINGENCY        10.00%         $2,439
BOND               0.00%         $0
PROFIT            10.00%         $2,439
JOB TOTAL                                     $29,264

```

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=====
Estimate:      BLDG 2787          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					20.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.98	\$44	\$91	\$0	\$0	\$135
A09 ELECTRICAL		48	\$709	\$1,463	\$0	\$0	\$2,172

=====						
Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	275.00 L.F.	
Totals	122.10	\$1,147	\$2,833	\$0	0.00	14.47
					\$0	\$3,980
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	320.00 L.F.	
Totals	40.64	\$525	\$920	\$0	0.00	4.52
					\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	38.00 Ea.	
Totals	19.00	\$1,512	\$145	\$0	0.00	43.59
					\$0	\$1,657
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	
Totals	3.00	\$738	\$120	\$0	0.00	858.50
					\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	
Totals	6.00	\$5,160	\$264	\$0	0.00	904.06
					\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
Unit values	4.00	935.00	81.70	0.00	1.00 Ea.	
Totals	4.00	\$935	\$82	\$0	0.00	1016.70
					\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	1.00 Ea.	
Totals	1.60	\$70	\$76	\$0	0.00	146.50
					\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	2.00 Ea.	
Totals	2.00	\$150	\$55	\$0	0.00	102.55
					\$0	\$205
U15 MECHANICAL	199	\$10,237	\$4,495	\$0	\$0	\$14,732

```
=====
Line #      Description
-----
              Manhours  Matl    Labor  Equipment  Sub      Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34

U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
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18-Oct-94

## MeansData for Lotus

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```
=====
Line #      Description
-----
           Manhours   Matl      Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	250	\$11,277	\$6,029	\$0	\$0	\$17,306
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,277	\$6,029	\$0	\$0	\$17,306
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,306

```

=====
Estimate:      BLDG 2787          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      48      $709      $1,463      $0      $0      $2,172
U15 MECHANICAL     199     $10,237     $4,495      $0      $0     $14,732
U16 ELECTRICAL       3      $331        $71      $0      $0      $402
TOTAL              250     $11,277     $6,029      $0      $0     $17,306

SALES TAX           0.00%        $0
MATL MARKUP         0.00%        $0
LABOR MARKUP        0.00%        $0
EQUIPT MARKUP       0.00%        $0
SUB MARKUP          0.00%        $0

TOTAL BEFORE CONTINGENC $11,277     $6,029      $0      $0     $17,306
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $17,306

```

17-Oct-94

## MeansData for Lotus

Page 1

```

=====
Estimate:      BLDG 2788
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS
Location:      FORT KNOX, KY
Sq. footage:   4800.00
Date:          14-Oct-94
Job #:         94013.02
City indx:    Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER						
Unit values	0.15	0.00	3.16	1.29	300.00 L.F.		
Totals	45.00	\$0	\$947	\$386	\$0	4.44	\$1,333
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH						
Unit values	12.00	0.00	323.82	0.00	1.00 Ea.		
Totals	12.00	\$0	\$324	\$0	\$0	323.82	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM						
Unit values	14.55	0.00	380.36	0.00	0.50 Ton		
Totals	7.27	\$0	\$190	\$0	\$0	380.36	\$190
208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE						
Unit values	0.07	0.00	1.97	0.24	300.00 L.F.		
Totals	21.30	\$0	\$592	\$71	\$0	2.21	\$663
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE						
Unit values	0.20	0.00	5.55	0.68	90.00 Ea.		
Totals	18.00	\$0	\$500	\$61	\$0	6.23	\$561
0268520600	GAS SERVICE & DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT & WRAP 2" DIAM						
Unit values	0.11	2.19	3.18	0.19	60.00 L.F.		
Totals	6.84	\$131	\$191	\$11	\$0	5.55	\$333
U02 SITEWORK		111	\$131	\$2,744	\$529	\$0	\$3,404

17-Oct-94

## MeansData for Lotus

Page 2

```
=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub      Total
=====
```

1554510245      HTG INFA-RD UNT GAS ELEC IGN      (See Attached for Breakdown)

Unit values	0.00	0.00	0.00	0.00	1.00 LS	17306.00
Totals	0.00	\$0	\$0	\$0	\$17,306	\$17,306

U15 MECHANICAL	0	\$0	\$0	\$0	\$17,306	\$17,306
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17-Oct-94

MeansData for Lotus

Page 3

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL	111		\$131	\$2,744	\$529	\$17,306	\$20,710
SALES TAX	0.00%		\$0				
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$131	\$2,744	\$529	\$17,306	\$20,710
CONTINGENCY	10.00%						\$2,071
BOND	0.00%						\$0
PROFIT	10.00%						\$2,071
JOB TOTAL							\$24,852

17-Oct-94

## MeansData for Lotus

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```

=====
Estimate:      BLDG 2788          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   4800.00           City indx: Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	111	\$131	\$2,744	\$529	\$0	\$3,404
U15 MECHANICAL	0	\$0	\$0	\$0	\$17,306	\$17,306
TOTAL	111	\$131	\$2,744	\$529	\$17,306	\$20,710
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$131	\$2,744	\$529	\$17,306	\$20,710
CONTINGENCY	10.00%					\$2,071
BOND	0.00%					\$0
PROFIT	10.00%					\$2,071
JOB TOTAL						\$24,852

```

=====
Estimate:      BLDG 2788           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					20.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.98	\$44	\$91	\$0	\$0	\$135
A09 ELECTRICAL		48	\$709	\$1,463	\$0	\$0	\$2,172

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					275.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	122.10	\$1,147	\$2,833	\$0	\$0	\$3,980
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
					320.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					38.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	19.00	\$1,512	\$145	\$0	\$0	\$1,657
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
					1.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE.					
					1.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					2.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	199	\$10,237	\$4,495	\$0	\$0	\$14,732



```
=====
Line #      Description
-----
           Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34

U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
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```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	250	\$11,277	\$6,029	\$0	\$0	\$17,306
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,277	\$6,029	\$0	\$0	\$17,306
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,306

```

=====
Estimate:      BLDG 2788           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      48      $709      $1,463          $0      $0      $2,172
U15 MECHANICAL     199     $10,237      $4,495          $0      $0     $14,732
U16 ELECTRICAL       3       $331        $71           $0      $0       $402
TOTAL              250     $11,277      $6,029          $0      $0     $17,306

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0

TOTAL BEFORE CONTINGENC $11,277      $6,029          $0      $0     $17,306
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $17,306

```

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=====
Estimate:      BLDG 2789          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   4800.00           City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					4.00 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		16.84	\$0	\$370	\$535	\$0	\$905
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					7.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		0.62	\$0	\$12	\$5	\$0	\$17
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					20.00 L.F.	
Unit values		0.01	0.00	0.24	0.24	0.00	0.47
Totals		0.20	\$0	\$5	\$5	\$0	\$10
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					8.00 S.Y.	
Unit values		0.05	17.52	1.07	1.02	0.00	19.61
Totals		0.39	\$140	\$9	\$8	\$0	\$157
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					1.50 C.Y.	

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## MeansData for Lotus

Page 2

Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.24	\$4	\$5	\$2	\$0	\$11
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	1.50 C.Y.	
Totals	0.13	\$0	\$3	\$1	0.00	2.41
					\$0	\$4
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	
Totals	1.56	\$260	\$35	\$6	0.00	300.98
					\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	20.00 L.F.	
Totals	1.34	\$15	\$30	\$0	0.00	2.23
					\$0	\$45
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	
Totals	5.35	\$96	\$148	\$9	0.00	5.06
					\$0	\$253

17-Oct-94

## MeansData for Lotus

Page 3

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK		129	\$515	\$3,019	\$1,200	\$0	\$4,734
1554510245	HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)						
Unit values		0.00	0.00	0.00	0.00	1.00 LS.	
Totals		0.00	\$0	\$0	\$0	17306.00	17306.00
1562600137	GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM						
Unit values	TYPE 1-1/4" PIPE SIZE	0.53	226.00	12.10	0.00	1.00 Ea.	
Totals		0.53	\$226	\$12	\$0	0.00	238.10
						\$0	\$238
U15 MECHANICAL		1	\$226	\$12	\$0	\$17,306	\$17,544

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	130	\$741	\$3,031	\$1,200	\$17,306	\$22,278
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$741	\$3,031	\$1,200	\$17,306	\$22,278
CONTINGENCY	10.00%					\$2,228
BOND	0.00%					\$0
PROFIT	10.00%					\$2,228
JOB TOTAL						\$26,734

```

=====
Estimate:      BLDG 2789           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:      LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  4800.00           City indx: Louisville, KY
=====

```

## SUMMARY

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Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      129      $515    $3,019    $1,200      $0      $4,734
U15 MECHANICAL     1      $226      $12      $0      $17,306    $17,544
TOTAL             130      $741    $3,031    $1,200    $17,306    $22,278

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC  $741    $3,031    $1,200    $17,306    $22,278
CONTINGENCY        10.00%      $2,228
BOND               0.00%      $0
PROFIT            10.00%      $2,228
JOB TOTAL                                     $26,734

```



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=====
Estimate:      BLDG 2789          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					300.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		44.70	\$665	\$1,372	\$0	\$0	\$2,037
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					20.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		2.98	\$44	\$91	\$0	\$0	\$135
A09 ELECTRICAL		48	\$709	\$1,463	\$0	\$0	\$2,172

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					275.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	122.10	\$1,147	\$2,833	\$0	\$0	\$3,980
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG.& HNDR SZD FOR CVRG 10' OC 1/2" DIAM					
					320.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	40.64	\$525	\$920	\$0	\$0	\$1,445
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					38.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	19.00	\$1,512	\$145	\$0	\$0	\$1,657
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
					1.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	4.00	\$935	\$82	\$0	\$0	\$1,017
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					1.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	1.60	\$70	\$76	\$0	\$0	\$146
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					2.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	2.00	\$150	\$55	\$0	\$0	\$205
U15 MECHANICAL	199	\$10,237	\$4,495	\$0	\$0	\$14,732

18-Oct-94

## MeansData for Lotus

Page 3

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=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
```

1631200100      HEATING SYSTEM POWER / CONTROL PANEL

Unit values	2.96	330.76	70.58	0.00	1.00 Ea.	
Totals	2.96	\$331	\$71	\$0	0.00	401.34
					\$0	\$402

U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
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```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====

ESTIMATE TOTAL      250    $11,277    $6,029         $0         $0    $17,306

SALES TAX            0.00%         $0
MATL MARKUP          0.00%         $0
LABOR MARKUP         0.00%         $0
EQUIPT MARKUP        0.00%         $0
SUB MARKUP           0.00%         $0

TOTAL BEFORE CONTINGENC $11,277    $6,029         $0         $0    $17,306
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     $17,306
```

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=====
Estimate:      BLDG 2789           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	48	\$709	\$1,463	\$0	\$0	\$2,172
U15 MECHANICAL	199	\$10,237	\$4,495	\$0	\$0	\$14,732
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	250	\$11,277	\$6,029	\$0	\$0	\$17,306
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$11,277	\$6,029	\$0	\$0	\$17,306
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$17,306

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2786		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		59 F	
INFILTRATION LOSSES =	1	AIR CHGS X	72000	VOL (CU FT) X	59 F TEMP DIFF X 0.019 = 0.08 MBTU / HR
FLOOR LOSSES =	320	LINEAR FEET OF PERIMETER X	59	F TEMP DIFF X	0.81 = 0.02 MBTU / HR
<b>SURFACE HEAT LOSSES</b>					
FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/GLAZED PERSONNEL =		AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
<b>TOTAL BASELINE HEAT LOSSES</b>				=	<b>0.25 MBTU / HR</b>
				=	<b>267.76 MJ/HR</b>

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2786 BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 72000 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.07 MBTU / HR  
FLOOR LOSSES = 320 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.01 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
MTL OVERHEAD DOORS =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG WOOD SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	0	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.23 MBTU / HR  
= 245.07 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2786	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	ECO - 1	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	60%	1	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.25	0.23	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

### ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.25	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY			
	0.6	SYS EFF	X	59	TEMP DIFFERENCE				=	794.26	MBTU/YR
	794.26	MBTU/YR							=		794.26
ECO - 1 =	0.23	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	389.56	MBTU/YR
	389.56	MBTU/YR							=		389.56
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	404.70	MBTU/YR
									=	426,960.77	MJ/YR

### ANNUAL HEATING ENERGY COST

BASELINE =	794.26	MBTU / YR	X	4.62	\$ /MBTU		=	3,669.49	\$ /YR
ECO - 1 =	389.56	MBTU / YR	X	4.62	\$ /MBTU		=	1,799.77	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS							=	1,869.72	\$ /YR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:	2787	BUILDING HEATING TEMPERATURE SETPOINT:		60 F	PAGE 1 OF 3
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		59 F	
INFILTRATION LOSSES =	1	AIR CHGS	X	72000	VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.08 MBTU / HR
FLOOR LOSSES =	320	LINEAR FEET OF PERIMETER		X	59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	4800	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.03 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
CORR MTL PNL WALL =		AREA (SF)	X	0.4	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
WOOD GLAZED O'HEAD DR =		AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=	25	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=		AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES					= 0.25 MBTU / HR
					= 267.76 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2787

BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 72000 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.07 MBTU / HR

FLOOR LOSSES = 320 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.01 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
MTL OVERHEAD DOORS =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG WOOD SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	0	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.23 MBTU / HR  
= 245.07 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	2787	GLOSSARY OF TERMS
1 MBTU = 1055 MJ		
0.019=CONSTANT		
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE		
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS		
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2		

SYSTEM EFFICIENCY	BASELINE	ECO - 1
OUTSIDE DESIGN TEMP (F)	60%	90%
HTG TEMP SETPOINT (F)	1	1
HEATING DEGREE DAYS	60	55
TOTAL HEAT LOSSES	4616	3396
(MBTU / HR)	0.25	0.23
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.25	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY			
	0.6	SYS EFF	X	59	TEMP DIFFERENCE				=	794.26	MBTU/YR
	794.26	MBTU/YR		X	CORR FACTOR		1		=	794.26	MBTU/YR
ECO - 1 =	0.23	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY			
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	389.56	MBTU/YR
	389.56	MBTU/YR		X	CORR FACTOR		1		=	389.56	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	404.70	MBTU/YR
									=	426,960.77	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	794.26	MBTU / YR	X	4.62	\$ /MBTU		=	3,669.49	\$ /YR
ECO - 1 =	389.56	MBTU / YR	X	4.62	\$ /MBTU		=	1,799.77	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=						=	1,869.72	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2788		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3				
		OUTSIDE DESIGN TEMPERATURE		1 F				
		TEMPERATURE DIFFERENCE		59 F				
INFILTRATION LOSSES =	1	AIR CHGS X	72000	VOL (CU FT) X	59 F TEMP DIFF X 0.019 =	0.08	MBTU / HR	
FLOOR LOSSES =	320	LINEAR FEET OF PERIMETER X		59 F TEMP DIFF X	0.81 =	0.02	MBTU / HR	
SURFACE HEAT LOSSES								
FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =		AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TOTAL BASELINE HEAT LOSSES						=	0.25	MBTU / HR
						=	267.76	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2788

BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 72000 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.07 MBTU / HR

FLOOR LOSSES = 320 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.01 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
CORR MTL PNL WALL =	0	AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR
MTL OVERHEAD DOORS =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG WOOD SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR=	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL=	0	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.23 MBTU / HR  
= 245.07 MJ/HR

## ECO - 1: INFRARED HEATING CALCULATIONS

**PAGE 3 OF 3**

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.25	0.23
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER	2788
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## GLOSSARY OF TERMS

$$1 \text{ MBTU} = 1055 \text{ MJ}$$

0.019=CONSTANT

.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE

**CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS**

65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

[illegible]

## ANNUAL HEATING ENERGY COST

BASELINE =	794.26	MBTU / YR	X	4.62	\$ /MBTU	=	3,669.49	\$ /YR
ECO - 1 =	389.56	MBTU / YR	X	4.62	\$ /MBTU	=	1,799.77	\$ /YR
<div>ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS = 1,869.72 \$ /YR</div>								

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2789 PAGE 1 OF 3

BUILDING HEATING TEMPERATURE SETPOINT: 60 F  
 OUTSIDE DESIGN TEMPERATURE 1 F  
 TEMPERATURE DIFFERENCE 59 F

INFILTRATION LOSSES = 1 AIR CHGS X 72000 VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.08 MBTU / HR  
 FLOOR LOSSES = 320 LINEAR FEET OF PERIMETER X 59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	4800	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2614	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
CORR MTL PNL WALL =		AREA (SF) X	0.4	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
CLR SGL PANE WINDOWS =	161	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
METAL ROLL UP DOORS =	1680	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
MTL OVERHEAD DOORS =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
WOOD GLAZED O'HEAD DR =		AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	25	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =		AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL BASELINE HEAT LOSSES

= 0.25 MBTU / HR  
 = 267.76 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2789		BUILDING HEATING TEMPERATURE SETPOINT: 55 F												
		OUTSIDE DESIGN TEMPERATURE 1 F												
		TEMPERATURE DIFFERENCE 54 F												
INFILTRATION LOSSES =		1	AIR CHGS	X	72000	VOL (CU FT)	X	54	F TEMP DIFF	X	0.019	=	0.07	MBTU / HR
FLOOR LOSSES =		320	LINEAR FEET OF PERIMETER		X	54	F TEMP DIFF	X	0.81	=	0.01	MBTU / HR		
SURFACE HEAT LOSSES														
FLAT BUILT UP ROOF =		4800	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =		2614	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR		
CORR MTL PNL WALL =		0	AREA (SF)	X	0.4	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
CLR SGL PANE WINDOWS =		161	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
METAL ROLL UP DOORS =		1680	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR		
MTL OVERHEAD DOORS =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
WOOD GLAZED O'HEAD DR =		0	AREA (SF)	X	0.583	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG WOOD SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=		25	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=		0	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES												=	0.23	MBTU / HR
												=	245.07	MJ/HR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2789	GLOSSARY OF TERMS
SYSTEM EFFICIENCY			
OUTSIDE DESIGN TEMP (F)	60%	90%	1 MBTU = 1055 MJ
HTG TEMP SETPOINT (F)	1	1	0.019=CONSTANT
HEATING DEGREE DAYS	60	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
TOTAL HEAT LOSSES	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
(MBTU / HR)	0.25	0.23	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.25	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	794.26	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
	794.26	MBTU/YR		X	CORR FACTOR		1		=	794.26	MBTU/YR
ECO - 1 =	0.23	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	389.56	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	389.56	MBTU/YR		X	CORR FACTOR		1		=	389.56	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	404.70	MBTU/YR
									=	426,960.77	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	794.26	MBTU / YR	X	4.62	\$ /MBTU	=	3,669.49	\$ /YR
ECO - 1 =	389.56	MBTU / YR	X	4.62	\$ /MBTU	=	1,799.77	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								1,869.72 \$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 2955ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      LCCID 1.080  
 PROJECT NO. & TITLE: 2955ECO1      ECO-1 INFRARED HEAT  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	101069.	
B. SIOH	\$	5053.	
C. DESIGN COST	\$	5053.	
D. TOTAL COST (1A+1B+1C)	\$	111176.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		111176.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	1761.	\$ 8134.	20.96	\$ 170486.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1761.	\$ 8134.		\$ 170486.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$	990.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	14593.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 11976.	5	.86	10299.
2. REPAIR2	\$ 11976.	15	.63	7545.
3. REPAIR3	\$ 3211.	7	.81	2601.
4. REPAIR4	\$ 3211.	14	.65	2087.

d. TOTAL      \$ 30374.      22533.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 37125.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 10643.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.45 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 207611.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  1.87  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.37 %

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Estimate:      BLDG 2955          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	
Totals	1.54	\$552	\$34	\$32	0.00	19.61
					\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	
Totals	0.72	\$11	\$15	\$6	0.00	7.17
					\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	
Totals	0.40	\$0	\$8	\$3	0.00	2.41
					\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	
Totals	1.56	\$260	\$35	\$6	0.00	300.98
					\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	
Totals	16.08	\$181	\$355	\$0	0.00	2.23
					\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	
Totals	5.35	\$96	\$148	\$9	0.00	5.06
					\$0	\$253

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=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals           0.00      $0        $0        $0    21687.00  21687.00
                                $0    $21,687    $21,687

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      1.00 Ea.
Totals           0.53    $226      $12        $0      0.00    238.10
                                $0        $0        $238

U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925

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=====
Line #      Description
-----
            Manhours   Matl    Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

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Estimate:      BLDG 2955          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
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SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	194	\$1,100	\$4,420	\$2,122	\$0	\$7,642
U15 MECHANICAL	1	\$226	\$12	\$0	\$21,687	\$21,925
TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2955          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377



=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 220.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM 340.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58        0.00    1.00 Ea.
Totals            2.96     $331      $71          $0    0.00    401.34
                                $0          $0        $0    $402

U16 ELECTRICAL      3      $331      $71          $0        $0    $402
```

```
=====
Line #      Description
-----
            Manhours   Matl      Labor   Equipment   Sub      Total
=====

ESTIMATE TOTAL      257    $15,239    $6,448        $0        $0    $21,687

SALES TAX            0.00%          $0
MATL MARKUP          0.00%          $0
LABOR MARKUP         0.00%          $0
EQUIPT MARKUP        0.00%          $0
SUB MARKUP           0.00%          $0

TOTAL BEFORE CONTINGENC $15,239    $6,448        $0        $0    $21,687
CONTINGENCY           0.00%          $0
BOND                  0.00%          $0
PROFIT                0.00%          $0

JOB TOTAL                                     $21,687
```

18-Oct-94

## MeansData for Lotus

Page 5

```

=====
Estimate:      BLDG 2955           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3       $331       $71        $0      $0       $402
TOTAL              257     $15,239     $6,448      $0      $0     $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $21,687

```

```

=====
Estimate:      BLDG 2959          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					300.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		45.00	\$0	\$947	\$386	\$0	\$1,333
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					300.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		21.30	\$0	\$592	\$71	\$0	\$663
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					90.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		18.00	\$0	\$500	\$61	\$0	\$561
0268520600	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 2" DIAM					60.00 L.F.	
Unit values		0.11	2.19	3.18	0.19	0.00	5.55
Totals		6.84	\$131	\$191	\$11	\$0	\$333
U02 SITEWORK		111	\$131	\$2,744	\$529	\$0	\$3,404

```
=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
1554510245  HTG INFA-RD UNT GAS ELEC IGN  (See Attached for Breakdown
                                1.00 LS
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0      $0      $0    $21,687  $21,687

U15 MECHANICAL      0      $0      $0      $0    $21,687  $21,687
```

```
=====
Line #      Description
-----
              Manhours   Matl      Labor    Equipment    Sub      Total
=====
```

ESTIMATE TOTAL	111	\$131	\$2,744	\$529	\$21,687	\$25,091
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$131	\$2,744	\$529	\$21,687	\$25,091
CONTINGENCY	10.00%					\$2,509
BOND	0.00%					\$0
PROFIT	10.00%					\$2,509
JOB TOTAL						\$30,109

```

=====
Estimate:      BLDG 2959          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      111    $131    $2,744    $529      $0    $3,404
U15 MECHANICAL      0      $0      $0      $0    $21,687    $21,687
TOTAL              111    $131    $2,744    $529    $21,687    $25,091

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC  $131    $2,744    $529    $21,687    $25,091
CONTINGENCY         10.00%      $2,509
BOND                 0.00%      $0
PROFIT              10.00%      $2,509
JOB TOTAL                                $30,109

```



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=====
Estimate:      BLDG 2959          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
-----						
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	220.00 L.F.	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	340.00 L.F.	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00        1.00 Ea.
Totals            2.96    $331      $71      $0        0.00    401.34
                        $0        $0        $0        $0        $402

U16 ELECTRICAL      3      $331      $71        $0        $0    $402
=====
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

ESTIMATE TOTAL      257    $15,239    $6,448        $0        $0    $21,687

SALES TAX            0.00%        $0
MATL MARKUP          0.00%        $0
LABOR MARKUP         0.00%        $0
EQUIPT MARKUP        0.00%        $0
SUB MARKUP           0.00%        $0

TOTAL BEFORE CONTINGENC $15,239    $6,448        $0        $0    $21,687
CONTINGENCY           0.00%
BOND                  0.00%
PROFIT                0.00%

JOB TOTAL                                     .    $21,687
=====
```

18-Oct-94

## MeansData for Lotus

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=====
Estimate:      BLDG 2959           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	53	\$776	\$1,601	\$0	\$0	\$2,377
U15 MECHANICAL	201	\$14,132	\$4,776	\$0	\$0	\$18,908
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2960           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    6900.00           City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values	0.11	0.00	2.35	1.01	0.00		3.36
Totals	5.60	\$0	\$118	\$50	\$0		\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values	0.14	0.00	2.94	1.26	0.00		4.20
Totals	21.00	\$0	\$441	\$190	\$0		\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122        $0    $7,642

1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687    $21,687

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00  238.10
Totals           0.53    $226      $12        $0        $0    $238

U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925

```



```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
ESTIMATE TOTAL      195    $1,326    $4,432    $2,122    $21,687    $29,567
SALES TAX            0.00%         $0
MATL MARKUP          0.00%         $0
LABOR MARKUP         0.00%         $0
EQUIPT MARKUP        0.00%         $0
SUB MARKUP           0.00%         $0
TOTAL BEFORE CONTINGENC $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY          10.00%         $2,957
BOND                 0.00%         $0
PROFIT              10.00%         $2,957
JOB TOTAL                                     $35,480
```

```

=====
Estimate:      BLDG 2960           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    6900.00           City indx: Louisville, KY
=====

```

## SUMMARY

```

-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122        $0    $7,642
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925
TOTAL              195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX          0.00%        $0
MATL MARKUP        0.00%        $0
LABOR MARKUP        0.00%        $0
EQUIPT MARKUP       0.00%        $0
SUB MARKUP          0.00%        $0

TOTAL BEFORE CONTINGENC  $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY         10.00%        $0
BOND                 0.00%        $0
PROFIT              10.00%        $0
JOB TOTAL                                     $35,480

```

18-Oct-94

MeansData for Lotus

Page 1

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=====
Estimate:      BLDG 2960      Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	230.00 L.F.	
Totals		34.27	\$510	\$1,052	\$0	0.00	6.79
						\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	120.00 L.F.	
Totals		17.88	\$266	\$549	\$0	0.00	6.79
						\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	220.00 L.F.	
Totals	97.68	\$917	\$2,267	\$0	\$0	14.47
						\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNDR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	340.00 L.F.	
Totals	43.18	\$558	\$978	\$0	\$0	4.52
						\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	
Totals	14.50	\$1,154	\$110	\$0	\$0	43.59
						\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	
Totals	3.00	\$738	\$120	\$0	\$0	858.50
						\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	
Totals	6.00	\$5,160	\$264	\$0	\$0	904.06
						\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	
Totals	6.00	\$1,065	\$163	\$0	\$0	1228.40
						\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	
Totals	16.00	\$3,740	\$327	\$0	\$0	1016.70
						\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	
Totals	8.00	\$350	\$382	\$0	\$0	146.50
						\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	
Totals	6.00	\$450	\$165	\$0	\$0	102.55
						\$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      $0        $402

U16 ELECTRICAL      3      $331      $71        $0        $0    $402
=====
```

18-Oct-94

MeansData for Lotus

Page 4

```
=====
Line #      Description
-----
              Manhours   Matl      Labor    Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2960           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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## SUMMARY

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Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3      $331       $71      $0      $0      $402
TOTAL                257     $15,239     $6,448      $0      $0     $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                     $21,687

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2955		BUILDING HEATING TEMPERATURE SETPOINT: 60 F					PAGE 1 OF 3								
		OUTSIDE DESIGN TEMPERATURE 1 F													
		TEMPERATURE DIFFERENCE 59 F													
INFILTRATION LOSSES =		1	AIR CHGS	X	114900	VOL (CU FT)	X	59	F TEMP DIFF	X	0.019	=	0.13	MBTU / HR	
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER					X	59	F TEMP DIFF	X	0.81	=	0.02	MBTU / HR
SURFACE HEAT LOSSES															
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.04	MBTU / HR	
FACE BRICK/BLK WALL =			AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.07	MBTU / HR	
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.01	MBTU / HR	
CLR SGL PANE WINDOWS =		760	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.06	MBTU / HR	
TINTED DBL PANE WIN'W =			AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.04	MBTU / HR	
METAL GLAZED O'HEAD DR =			AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
LG MTL SLIDING DOOR =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
METAL PERSONNEL DR=			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)		X	59	F TEMPERATURE DIFFERENCE		=	0.00	MBTU / HR	
TOTAL BASELINE HEAT LOSSES												=	0.37	MBTU / HR	
												=	388.28	MJ/HR	



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2955		BUILDING HEATING TEMPERATURE SETPOINT: 55 F							PAGE 2 OF 3			
		OUTSIDE DESIGN TEMPERATURE										
		TEMPERATURE DIFFERENCE										
		1 F										
		54 F										
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER	X				54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.04	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.06	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =	760	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.05	MBTU / HR
TINTED DBL PANE WIN"W =	0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.04	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE			=	0.00	MBTU / HR
TOTAL ECO HEAT LOSSES										=	0.34	MBTU / HR
										=	355.37	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2955	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	ECO - 1	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	90%	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.37	0.34	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.37	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,151.76	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	0.34	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	564.90	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,151.76	MBTU/YR	X	CORR FACTOR	1				=	564.90	MBTU/YR
	564.90	MBTU/YR	X	CORR FACTOR	1				=	564.90	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS =										586.86	MBTU/YR
										619,135.94	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,151.76	MBTU / YR	X	4.62	\$ /MBTU	=	5,321.13	\$ /YR
ECO - 1 =	564.90	MBTU / YR	X	4.62	\$ /MBTU	=	2,609.84	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =							2,711.29	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3

BUILDING NUMBER: 2959 BUILDING HEATING TEMPERATURE SETPOINT: 60 F  
 OUTSIDE DESIGN TEMPERATURE 1 F  
 TEMPERATURE DIFFERENCE 59 F

INFILTRATION LOSSES = 1 AIR CHGS X 114900 VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR

FLOOR LOSSES = 350 LINEAR FEET OF PERIMETER X 59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =	760	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
TINTED DBL PANE WIN'W =		AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

TOTAL BASELINE HEAT LOSSES  
 = 0.37 MBTU / HR  
 = 388.28 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2959		BUILDING HEATING TEMPERATURE SETPOINT: 55 F				PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
		54 F					
		1 F					
		54 F					

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2959	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	0.34	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.37	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$4.62	\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.37	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,151.76	MBTU/YR
	0.6	SYSEFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,151.76	MBTU/YR	X	CORR FACTOR	1				=	1,151.76	MBTU/YR
	0.34	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	564.90	MBTU/YR
	0.9	SYSEFF	X	54	TEMP DIFFERENCE						
	564.90	MBTU/YR	X	CORR FACTOR	1				=	564.90	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	586.86	MBTU/YR
									=	619,135.94	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,151.76	MBTU / YR	X	4.62	\$ /MBTU	=	5,321.13	\$ /YR
ECO - 1 =	564.90	MBTU / YR	X	4.62	\$ /MBTU	=	2,609.84	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS						=	2,711.29	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		2960		BUILDING HEATING TEMPERATURE SETPOINT:				60 F		PAGE 1 OF 3				
				OUTSIDE DESIGN TEMPERATURE				1 F						
				TEMPERATURE DIFFERENCE				59 F						
INFILTRATION LOSSES =		1	AIR CHGS	X	114900	VOL (CU FT)	X	59	F TEMP DIFF	X	0.019	=	0.13	MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER		X	59	F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES														
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
FACE BRICK/BLK WALL =			AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR		
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
CLR SGL PANE WINDOWS =		760	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
TINTED DBL PANE WIN'W =			AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
METAL GLAZED O'HEAD DR =			AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL BASELINE HEAT LOSSES											=	0.37	MBTU / HR	
											=	388.28	MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2960		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE						
		TEMPERATURE DIFFERENCE						
		1 F						
		54 F						
INFILTRATION LOSSES =		1	AIR CHGS X	114900	VOL (CU FT) X	54 F TEMP DIFF X	0.019	= 0.12 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER X		54 F TEMP DIFF X	0.81	= 0.02 MBTU / HR	
SURFACE HEAT LOSSES								
FLAT BUILT UP ROOF =		6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR	
FACE BRICK/BLK WALL =		0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
8" CINDER BLOCK WALL =		2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.06 MBTU / HR	
CORR MTL PNL WALL =		1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR	
CLR SGL PANE WINDOWS =		760	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.05 MBTU / HR	
TINTED DBL PANE WIN"W =		0	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
METAL ROLL UP DOORS =		1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR	
WOOD GLAZED O'HEAD DR =		0	AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
LG MTL SLIDING DOOR =		0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
MTL/ GLAZED PERSONNEL=		25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR	
TOTAL ECO HEAT LOSSES							= 0.34 MBTU / HR	
							= 355.37 MJ/HR	

## ECO - 1: INFRARED HEATING CALCULATIONS

**PAGE 3 OF 3**

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.37	0.34

**ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)**

[illegible]

## ANNUAL HEATING ENERGY COST

BASELINE =	1,151.76	MBTU / YR X	4.62	\$ /MBTU	=	5,321.13	\$ /YR
ECO - 1 =	564.90	MBTU / YR X	4.62	\$ /MBTU	=	2,609.84	\$ /YR
<div>ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS = 2,711.29 \$ /YR</div>							



LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      STUDY: 2961ECO1  
 INSTALLATION & LOCATION: FORT KNOX      REGION NOS.      LCCID 1.080  
 PROJECT NO. & TITLE: 2961ECO1      ECO-1 INFRARED HEAT      CENSUS: 3  
 FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED  
 ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	106829.	
B. SIOH	\$	5341.	
C. DESIGN COST	\$	5341.	
D. TOTAL COST (1A+1B+1C)	\$	117512.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$ 117512.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU (1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	3340.	\$ 22045.	17.56	\$ 387113.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1638.	\$ -7569.	20.96	\$ -158640.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1702.	\$ 14476.		\$ 228473.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 990.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 14593.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-)	YR OC	DISCNT FACTR	DISCOUNTED SAVINGS (+) / COST (-) (4)
	(1)	(2)	(3)	
1. REPAIR	\$ 11976.	5	.86	10299.
2. REPAIR2	\$ 11976.	15	.63	7545.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.

d. TOTAL      \$ 25770.      19171.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 33764.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 16755.

5. SIMPLE PAYBACK PERIOD (1G/4) 7.01 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 262237.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  2.23  
 (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.32 %

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Estimate:      BLDG 2961          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

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Line #      Description
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            Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals           0.00      $0        $0        $0    21687.00  21687.00
                                $0    $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      1.00 Ea.
Totals           0.53    $226      $12        $0      0.00    238.10
                                $0          $0    $238
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925

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Line #      Description
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      Manhours  Matl    Labor   Equipment   Sub    Total
=====
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ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

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Estimate:      BLDG 2961           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx: Louisville, KY
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## SUMMARY

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=====
Manhours      Matl      Labor      Equipment      Sub      Total
=====
U02 SITEWORK      194      $1,100      $4,420      $2,122      $0      $7,642
U15 MECHANICAL      1        $226        $12        $0      $21,687      $21,925
TOTAL              195      $1,326      $4,432      $2,122      $21,687      $29,567

SALES TAX          0.00%        $0
MATL MARKUP        0.00%        $0
LABOR MARKUP       0.00%        $0
EQUIPT MARKUP      0.00%        $0
SUB MARKUP         0.00%        $0

TOTAL BEFORE CONTINGENC $1,326      $4,432      $2,122      $21,687      $29,567
CONTINGENCY        10.00%        $2,957
BOND               0.00%        $0
PROFIT            10.00%        $2,957
JOB TOTAL                                $35,480
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Estimate:      BLDG 2961          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

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Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					220.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10' OC 1/2" DIAM					
					340.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					29.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
					1.00 Ea.	
Unit values	6.00	1065.00	163.40	0.00	0.00	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
					4.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					5.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					6.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615



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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
U15 MECHANICAL		201	\$14,132	\$4,776	\$0	\$0	\$18,908
1631200100	HEATING SYSTEM POWER / CONTROL PANEL						
Unit values		2.96	330.76	70.58	0.00	1.00 Ea. 0.00	401.34
Totals		2.96	\$331	\$71	\$0	\$0	\$402
U16 ELECTRICAL		3	\$331	\$71	\$0	\$0	\$402

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Line #      Description
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              Manhours   Matl      Labor   Equipment   Sub      Total
=====
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ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

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Estimate:      BLDG 2961          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:  City indx:Louisville, KY
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## SUMMARY

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Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53    $776    $1,601        $0    $0    $2,377
U15 MECHANICAL    201   $14,132    $4,776        $0    $0   $18,908
U16 ELECTRICAL      3    $331     $71          $0    $0    $402
TOTAL              257   $15,239    $6,448        $0    $0   $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239    $6,448        $0    $0   $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                     $21,687

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=====
Estimate:      BLDG 2963          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	

Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					
					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
					31.50 S.Y.	
Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
					4.50 C.Y.	
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
					4.50 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
					1.00 Ea.	
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
					240.00 L.F.	
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
					50.00 L.F.	
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub      Total
=====
U02 SITEWORK      206    $1,100    $4,744    $2,122        $0    $7,966
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00  238.10
Totals           0.53    $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925
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=====
Line #      Description
-----
      Manhours  Matl    Labor   Equipment   Sub    Total
=====
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ESTIMATE TOTAL	207	\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
CONTINGENCY	10.00%					\$2,989
BOND	0.00%					\$0
PROFIT	10.00%					\$2,989
JOB TOTAL						\$35,869

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=====
Estimate:      BLDG 2963          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP (GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx: Louisville, KY
=====

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## SUMMARY

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-----
              Manhours   Matl     Labor   Equipment   Sub   Total
=====
U02 SITEWORK      206     $1,100   $4,744   $2,122       $0     $7,966
U15 MECHANICAL      1       $226     $12       $0     $21,687   $21,925
TOTAL             207     $1,326   $4,756   $2,122   $21,687   $29,891

SALES TAX          0.00%       $0
MATL MARKUP        0.00%       $0
LABOR MARKUP       0.00%       $0
EQUIPT MARKUP      0.00%       $0
SUB MARKUP         0.00%       $0

TOTAL BEFORE CONTINGENC $1,326   $4,756   $2,122   $21,687   $29,891
CONTINGENCY        10.00%       $2,989
BOND               0.00%       $0
PROFIT            10.00%       $2,989
JOB TOTAL                                     $35,869

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=====
Estimate:      BLDG 2963           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
		Manhours	Matl	Labor	Equipment	Sub Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					220.00 L.F.
Unit values		0.44	4.17	10.30	0.00	0.00 14.47
Totals		97.68	\$917	\$2,267	\$0	\$0 \$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					340.00 L.F.
Unit values		0.13	1.64	2.88	0.00	0.00 4.52
Totals		43.18	\$558	\$978	\$0	\$0 \$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					29.00 Ea.
Unit values		0.50	39.79	3.80	0.00	0.00 43.59
Totals		14.50	\$1,154	\$110	\$0	\$0 \$1,264
1524105040	VACUUM PUMP AND VENT PIPING					1.00 Ea.
Unit values		3.00	738.35	120.15	0.00	0.00 858.50
Totals		3.00	\$738	\$120	\$0	\$0 \$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					6.00 Ea.
Unit values		1.00	860.00	44.06	0.00	0.00 904.06
Totals		6.00	\$5,160	\$264	\$0	\$0 \$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					1.00 Ea.
Unit values		6.00	1065.00	163.40	0.00	0.00 1228.40
Totals		6.00	\$1,065	\$163	\$0	\$0 \$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					4.00 Ea.
Unit values		4.00	935.00	81.70	0.00	0.00 1016.70
Totals		16.00	\$3,740	\$327	\$0	\$0 \$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					5.00 Ea.
Unit values		1.60	70.00	76.50	0.00	0.00 146.50
Totals		8.00	\$350	\$382	\$0	\$0 \$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					6.00 Ea.
Unit values		1.00	75.00	27.55	0.00	0.00 102.55
Totals		6.00	\$450	\$165	\$0	\$0 \$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      $0        $402

U16 ELECTRICAL      3      $331      $71      $0        $0    $402
=====
```

```
=====
Line #      Description
-----
      Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2963      Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

=====

SUMMARY

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	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	53	\$776	\$1,601	\$0	\$0	\$2,377
U15 MECHANICAL	201	\$14,132	\$4,776	\$0	\$0	\$18,908
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2964          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI CONCRETE, 12" THICK					31.50 S.Y.
Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR BANK					4.50 C.Y.
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					4.50 C.Y.
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					1.00 Ea.
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- PSI 2" DIAM COIL SDR 11					240.00 L.F.
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 1"DIAM					50.00 L.F.
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```
=====
Line #      Description
-----
              Manhours   Matl      Labor    Equipment    Sub      Total
=====
U02 SITEWORK      194      $1,100    $4,420    $2,122        $0      $7,642

1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687  $21,687

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53      226.00    12.10      0.00      0.00  238.10
Totals           0.53      $226      $12        $0        $0      $238

U15 MECHANICAL      1      $226      $12        $0    $21,687  $21,925
=====
```



```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2964          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122        $0    $7,642
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925
TOTAL              195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX          0.00%        $0
MATL MARKUP        0.00%        $0
LABOR MARKUP       0.00%        $0
EQUIPT MARKUP      0.00%        $0
SUB MARKUP         0.00%        $0

TOTAL BEFORE CONTINGENC $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY        10.00%        $2,957
BOND               0.00%        $0
PROFIT            10.00%        $2,957
JOB TOTAL                                     $35,480

```

```

=====
Estimate:      BLDG 2964           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx: Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	230.00 L.F.	
Totals		34.27	\$510	\$1,052	\$0	\$0	6.79 \$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	120.00 L.F.	
Totals		17.88	\$266	\$549	\$0	\$0	6.79 \$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
		Manhours	Matl	Labor	Equipment	Sub Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					220.00 L.F.
Unit values		0.44	4.17	10.30	0.00	0.00 14.47
Totals		97.68	\$917	\$2,267	\$0	\$0 \$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					340.00 L.F.
Unit values		0.13	1.64	2.88	0.00	0.00 4.52
Totals		43.18	\$558	\$978	\$0	\$0 \$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					29.00 Ea.
Unit values		0.50	39.79	3.80	0.00	0.00 43.59
Totals		14.50	\$1,154	\$110	\$0	\$0 \$1,264
1524105040	VACUUM PUMP AND VENT PIPING					1.00 Ea.
Unit values		3.00	738.35	120.15	0.00	0.00 858.50
Totals		3.00	\$738	\$120	\$0	\$0 \$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					6.00 Ea.
Unit values		1.00	860.00	44.06	0.00	0.00 904.06
Totals		6.00	\$5,160	\$264	\$0	\$0 \$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					1.00 Ea.
Unit values		6.00	1065.00	163.40	0.00	0.00 1228.40
Totals		6.00	\$1,065	\$163	\$0	\$0 \$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					4.00 Ea.
Unit values		4.00	935.00	81.70	0.00	0.00 1016.70
Totals		16.00	\$3,740	\$327	\$0	\$0 \$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					5.00 Ea.
Unit values		1.60	70.00	76.50	0.00	0.00 146.50
Totals		8.00	\$350	\$382	\$0	\$0 \$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					6.00 Ea.
Unit values		1.00	75.00	27.55	0.00	0.00 102.55
Totals		6.00	\$450	\$165	\$0	\$0 \$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00        1.00 Ea.  401.34
Totals           2.96    $331      $71        $0        $0        $402

U16 ELECTRICAL      3      $331      $71        $0        $0    $402
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

ESTIMATE TOTAL      257    $15,239    $6,448          $0          $0    $21,687

SALES TAX            0.00%          $0
MATL MARKUP          0.00%          $0
LABOR MARKUP         0.00%          $0
EQUIPT MARKUP        0.00%          $0
SUB MARKUP           0.00%          $0

TOTAL BEFORE CONTINGENC $15,239    $6,448          $0          $0    $21,687
CONTINGENCY           0.00%          $0
BOND                  0.00%          $0
PROFIT                0.00%          $0

JOB TOTAL                                $21,687
```

```

=====
Estimate:      BLDG 2964           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3      $331       $71       $0      $0      $402
TOTAL              257     $15,239     $6,448      $0      $0     $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $21,687

```

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2961		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		59 F	
INFILTRATION LOSSES =		1	AIR CHGS X	114900	VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER X	59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR	
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =	760	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
TINTED DBL PANE WIN'W =		AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES				=	0.37 MBTU / HR
				=	388.28 MJ/HR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2961		BUILDING HEATING TEMPERATURE SETPOINT: 55 F							PAGE 2 OF 3			
		OUTSIDE DESIGN TEMPERATURE										
		TEMPERATURE DIFFERENCE										
		1 F										
		54 F										
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
CLR SGL PANE WINDOWS =	760	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR		
TINTED DBL PANE WIN"W =	0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
WOOD GLAZED O'HEAD DR =	0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES										=	0.34	MBTU / HR
										=	355.37	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.37	0.34
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 2961

### GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.37	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,151.76	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,151.76	MBTU/YR				X		CORR FACTOR		1	
	0.34	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	564.90	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	564.90	MBTU/YR				X		CORR FACTOR		1	
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	586.86	MBTU/YR
										619,135.94	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,151.76	MBTU / YR	X	6.6	\$ /MBTU	=	7,601.62	\$ /YR
ECO - 1 =	564.90	MBTU / YR	X	4.62	\$ /MBTU	=	2,609.84	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	4,991.77	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2963		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		59 F	
INFILTRATION LOSSES =	1	AIR CHGS X	114900	VOL (CU FT) X	59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X	59	F TEMP DIFF X	0.81 = 0.02 MBTU / HR
<b>SURFACE HEAT LOSSES</b>					
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
<b>TOTAL BASELINE HEAT LOSSES</b>				=	<b>0.33 MBTU / HR</b>
				=	<b>349.48 MJ/HR</b>

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2963

BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 114900 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.12 MBTU / HR  
FLOOR LOSSES = 350 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =	0	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TINTED DBL PANE WIN"W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.30 MBTU / HR  
= 319.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2963	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	0.30	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	0.33	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)		\$4.62	
\$ /MBTU -FUEL OIL		\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,036.66	MBTU/YR	X		CORR FACTOR		1		=	1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X		CORR FACTOR		1		=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS									=	528.21	MBTU/YR
									=	557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	6.6	\$ /MBTU	=	6,841.99	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS						=	4,492.94	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2964		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE 1 F			
		TEMPERATURE DIFFERENCE 59 F			
INFILTRATION LOSSES =		1	AIR CHGS X	114900	VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER X	59 F TEMP DIFF X 0.81 =	0.02 MBTU / HR
SURFACE HEAT LOSSES					
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =	760	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
TINTED DBL PANE WIN'W =		AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES				=	0.37 MBTU / HR
				=	388.28 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2964		BUILDING HEATING TEMPERATURE SETPOINT: 55 F							PAGE 2 OF 3			
		OUTSIDE DESIGN TEMPERATURE 1 F										
		TEMPERATURE DIFFERENCE 54 F										
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
CLR SGL PANE WINDOWS =	760	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.05	MBTU / HR		
TINTED DBL PANE WIN'W =	0	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
WOOD GLAZED O'HEAD DR =	0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES										=	0.34	MBTU / HR
										=	355.37	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

BUILDING NUMBER	2964
GLOSSARY OF TERMS	
1 MBTU = 1055 MJ	
0.019=CONSTANT	
.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE	
CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS	
65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2	

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.37	0.34
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.37	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,151.76	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,151.76	MBTU/YR							=	1,151.76	MBTU/YR
	0.34	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	564.90	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	564.90	MBTU/YR							=	564.90	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	586.86	MBTU/YR
										619,135.94	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,151.76	MBTU / YR	X	6.6	\$ /MBTU	=	7,601.62	\$ /YR
ECO - 1 =	564.90	MBTU / YR	X	4.62	\$ /MBTU	=	2,609.84	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	4,991.77	\$ /YR



LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2969ECO1

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID 1.080

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 2969ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS      PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	71349.	
B. SIOH	\$	3567.	
C. DESIGN COST	\$	3567.	
D. TOTAL COST (1A+1B+1C)	\$	78484.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		78484.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	2073.	\$ 13684.	17.56	\$ 240289.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1017.	\$ -4698.	20.96	\$ -98472.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1056.	\$ 8986.		\$ 141818.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)		\$	990.
(1) DISCOUNT FACTOR (TABLE A)	14.74		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	14593.

B. NON RECURRING SAVINGS (+) / COSTS (-)

ITEM	SAVINGS (+) COST (-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS (+) / COST (-) (4)
1. REPAIR	\$ 7984.	5	.86	6866.
2. REPAIR2	\$ 7984.	15	.63	5030.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 20896.	3	.91	19015.
d. TOTAL	\$ 38682.			32239.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) (3A2+3Bd4) \$ 46831.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 11910.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.59 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 188649.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.40  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.72 %

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Estimate:      BLDG 2969      Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP (GLASS Bid Date:
Location:       FORT KNOX, KY  Job #:      94013.02
Sq. footage:    6900.00      City indx: Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64		0.00	226.16
Totals	35.79	\$0	\$786	\$1,136		\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29		0.00	4.44
Totals	60.00	\$0	\$1,262	\$514		\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values	0.11	0.00	2.35	1.01		0.00	3.36
Totals	5.60	\$0	\$118	\$50		\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values	0.14	0.00	2.94	1.26		0.00	4.20
Totals	21.00	\$0	\$441	\$190		\$0	\$631
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values	12.00	0.00	323.82	0.00		0.00	323.82
Totals	12.00	\$0	\$324	\$0		\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00		0.00	380.36
Totals	7.27	\$0	\$190	\$0		\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24		0.00	2.21
Totals	14.20	\$0	\$395	\$47		\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68		0.00	6.23
Totals	20.00	\$0	\$555	\$68		\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD 16.00 C.Y.						

18-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.09	0.00	1.74	0.67	0.00	
Totals	1.42	\$0	\$28	\$11	\$0	2.41
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					
Unit values	0.01	0.00	0.24	0.24	210.00 L.F.	
Totals	2.10	\$0	\$50	\$50	\$0	0.47
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	
Totals	1.54	\$552	\$34	\$32	\$0	19.61
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	
Totals	0.72	\$11	\$15	\$6	\$0	7.17
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	
Totals	0.40	\$0	\$8	\$3	\$0	2.41
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	
Totals	1.56	\$260	\$35	\$6	\$0	300.98
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	
Totals	16.08	\$181	\$355	\$0	\$0	2.23
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	
Totals	5.35	\$96	\$148	\$9	\$0	5.06
						\$253

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=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      206    $1,100    $4,744    $2,122        $0    $7,966

1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687    $21,687

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00     12.10      0.00      0.00    238.10
Totals           0.53    $226      $12        $0        $0    $238

U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925
```

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=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment    Sub    Total
=====
```

ESTIMATE TOTAL	207	\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
CONTINGENCY	10.00%					\$2,989
BOND	0.00%					\$0
PROFIT	10.00%					\$2,989
JOB TOTAL						\$35,869

```

=====
Estimate:      BLDG 2969          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

## SUMMARY

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-----
              Manhours   Matl    Labor   Equipment   Sub       Total
=====
U02 SITEWORK      206    $1,100   $4,744   $2,122      $0    $7,966
U15 MECHANICAL      1      $226     $12      $0    $21,687   $21,925
TOTAL              207    $1,326   $4,756   $2,122   $21,687   $29,891

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326   $4,756   $2,122   $21,687   $29,891
CONTINGENCY        10.00%      $2,989
BOND               0.00%      $0
PROFIT            10.00%      $2,989
JOB TOTAL                                     $35,869

```

```

=====
Estimate:      BLDG 2969           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 220.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNDR SZD FOR CVRG 10'OC 1/2" DIAM 340.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS 29.00 Ea.					
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING 1.00 Ea.					
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER 6.00 Ea.					
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH 1.00 Ea.					
Unit values	6.00	1065.00	163.40	0.00	0.00	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH 4.00 Ea.					
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE 5.00 Ea.					
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING 6.00 Ea.					
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615



```
=====
Line #      Description
-----
      Manhours   Matl     Labor   Equipment   Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776         $0         $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58     0.00         1.00 Ea.  401.34
Totals           2.96    $331      $71        $0         $0         $402
U16 ELECTRICAL      3      $331      $71        $0         $0         $402
=====
```

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2969           Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

## SUMMARY

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=====
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3      $331       $71       $0      $0      $402
TOTAL                257     $15,239     $6,448      $0      $0     $21,687

SALES TAX            0.00%      $0
MATL MARKUP          0.00%      $0
LABOR MARKUP         0.00%      $0
EQUIPT MARKUP        0.00%      $0
SUB MARKUP           0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY           0.00%      $0
BOND                  0.00%      $0
PROFIT                0.00%      $0
JOB TOTAL                                     $21,687
=====

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=====
Estimate:      BLDG 2972          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:   6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					31.50 S.Y.
Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					4.50 C.Y.
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
					4.50 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
					1.00 Ea.	
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					240.00 L.F.
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					50.00 L.F.
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122        $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values              0.00      0.00      0.00      0.00      1.00 LS.
Totals                0.00      $0      $0      $0    21687.00    21687.00
                                $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values              0.53    226.00      12.10      0.00      1.00 Ea.
Totals                0.53    $226      $12      $0      0.00    238.10
                                $238
U15 MECHANICAL      1      $226      $12      $0    $21,687    $21,925

```

```
=====
Line #      Description
-----
              Manhours   Matl      Labor    Equipment   Sub      Total
=====

ESTIMATE TOTAL      195      $1,326      $4,432      $2,122      $21,687      $29,567

SALES TAX            0.00%              $0
MATL MARKUP          0.00%              $0
LABOR MARKUP         0.00%              $0
EQUIPT MARKUP        0.00%              $0
SUB MARKUP           0.00%              $0

TOTAL BEFORE CONTINGENC $1,326      $4,432      $2,122      $21,687      $29,567
CONTINGENCY          10.00%              $2,957
BOND                  0.00%              $0
PROFIT               10.00%              $2,957

JOB TOTAL                                     $35,480
```

```

=====
Estimate:      BLDG 2972          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
=====

```

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SUMMARY

=====

	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	194	\$1,100	\$4,420	\$2,122	\$0	\$7,642
U15 MECHANICAL	1	\$226	\$12	\$0	\$21,687	\$21,925
TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480



```

=====
Estimate:      BLDG 2972          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					220.00 L.F.	
Unit values		0.44	4.17	10.30	0.00	0.00	14.47
Totals		97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					340.00 L.F.	
Unit values		0.13	1.64	2.88	0.00	0.00	4.52
Totals		43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					29.00 Ea.	
Unit values		0.50	39.79	3.80	0.00	0.00	43.59
Totals		14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					1.00 Ea.	
Unit values		3.00	738.35	120.15	0.00	0.00	858.50
Totals		3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					6.00 Ea.	
Unit values		1.00	860.00	44.06	0.00	0.00	904.06
Totals		6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					1.00 Ea.	
Unit values		6.00	1065.00	163.40	0.00	0.00	1228.40
Totals		6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					4.00 Ea.	
Unit values		4.00	935.00	81.70	0.00	0.00	1016.70
Totals		16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					5.00 Ea.	
Unit values		1.60	70.00	76.50	0.00	0.00	146.50
Totals		8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					6.00 Ea.	
Unit values		1.00	75.00	27.55	0.00	0.00	102.55
Totals		6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U15 MECHANICAL      201    $14,132    $4,776         $0         $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58     0.00         1.00 Ea.
Totals           2.96     $331     $71        $0         0.00    401.34
                                   $0         $0         $0         $402

U16 ELECTRICAL      3      $331      $71         $0         $0    $402
=====
```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2972          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

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SUMMARY

-----

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	53	\$776	\$1,601	\$0	\$0	\$2,377
U15 MECHANICAL	201	\$14,132	\$4,776	\$0	\$0	\$18,908
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2969		BUILDING HEATING TEMPERATURE SETPOINT: 60 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
		1 F					
		59 F					
INFILTRATION LOSSES =		1	AIR CHGS X	114900	VOL (CU FT) X	59 F TEMP DIFF X 0.019	= 0.13 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER X	59	F TEMP DIFF X 0.81	=	0.02 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =		6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR
FACE BRICK/BLK WALL =			AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
8" CINDER BLOCK WALL =		2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.07 MBTU / HR
CORR MTL PNL WALL =		1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR
CLR SGL PANE WINDOWS =			AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TINTED DBL PANE WIN'W =		485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR
METAL ROLL UP DOORS =		1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =			AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
LG MTL SLIDING DOOR =			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL PERSONNEL DR=			AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
MTL/GLAZED PERSONNEL=		25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES							= 0.33 MBTU / HR
							= 349.48 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2969		BUILDING HEATING TEMPERATURE SETPOINT: 55 F							PAGE 2 OF 3				
		OUTSIDE DESIGN TEMPERATURE 1 F											
		TEMPERATURE DIFFERENCE 54 F											
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54	F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER		X	54	F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES													
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
CLR SGL PANE WINDOWS =	0	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TINTED DBL PANE WIN'W =	485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR		
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
WOOD GLAZED O'HEAD DR =	0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL ECO HEAT LOSSES											=	0.30	MBTU / HR
											=	319.86	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.33	0.30
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 2969

### GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,036.66	MBTU/YR							=	1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR							=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	528.21	MBTU/YR
										557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	6.6	\$ /MBTU	=	6,841.99	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	4,492.94	\$ /YR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2972		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE		1 F	
		TEMPERATURE DIFFERENCE		59 F	
INFILTRATION LOSSES =	1	AIR CHGS X	114900	VOL (CU FT) X	59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X		59 F TEMP DIFF X 0.81 =	0.02 MBTU / HR
<b>SURFACE HEAT LOSSES</b>					
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
<b>TOTAL BASELINE HEAT LOSSES</b>				=	<b>0.33 MBTU / HR</b>
				=	<b>349.48 MJ/HR</b>

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2972		BUILDING HEATING TEMPERATURE SETPOINT: 55 F		OUTSIDE DESIGN TEMPERATURE 1 F		TEMPERATURE DIFFERENCE 54 F		PAGE 2 OF 3	
INFILTRATION LOSSES =	1	AIR CHGS X	114900	VOL (CU FT) X	54 F	TEMP DIFF X	0.019 =	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X	54 F	TEMP DIFF X	0.81 =	0.02	MBTU / HR		
SURFACE HEAT LOSSES									
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =	0	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR=	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TOTAL ECO HEAT LOSSES							=	0.30	MBTU / HR
							=	319.86	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2972	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	ECO - 1	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	90%	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	0.33	0.30	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)			
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,036.66	MBTU/YR	X		CORR FACTOR	1			=	1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X		CORR FACTOR	1			=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	528.21	MBTU/YR
										557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	6.6	\$ /MBTU	=	6,841.99	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	4,492.94	\$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2970ECO1

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID 1.080

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 2970ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS      PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	71349.	
B. SIOH	\$	3567.	
C. DESIGN COST	\$	3567.	
D. TOTAL COST (1A+1B+1C)	\$	78484.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		78484.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	2073.	\$ 13684.	17.56	\$ 240289.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	-1017.	\$ -4698.	20.96	\$ -98472.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		1056.	\$ 8986.		\$ 141818.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	14.74	\$ 990.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 14593.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 7984.	5	.86	6866.
2. REPAIR2	\$ 7984.	15	.63	5030.
3. REPAIR3	\$ 909.	7	.81	736.
4. REPAIR4	\$ 909.	14	.65	591.
5. ENVIR	\$ 20621.	3	.91	18765.
d. TOTAL	\$ 38407.			31988.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 46581.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 11896.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.60 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 188399.

7. SAVINGS TO INVESTMENT RATIO (SIR) = (6 / 1G) = 2.40  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.71 %

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Estimate:      BLDG 2970          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	

Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					
					210.00 L.F.	
Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	
Totals	0.72	\$11	\$15	\$6	0.00	7.17
					\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	
Totals	0.40	\$0	\$8	\$3	0.00	2.41
					\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	
Totals	1.56	\$260	\$35	\$6	0.00	300.98
					\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	
Totals	16.08	\$181	\$355	\$0	0.00	2.23
					\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	
Totals	5.35	\$96	\$148	\$9	0.00	5.06
					\$0	\$253

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Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      206    $1,100    $4,744    $2,122      $0    $7,966
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals           0.00      $0        $0        $0    21687.00    21687.00
                                           $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      1.00 Ea.
Totals           0.53    $226      $12        $0      0.00    238.10
                                           $0        $238
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925

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Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
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ESTIMATE TOTAL	207	\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,756	\$2,122	\$21,687	\$29,891
CONTINGENCY	10.00%					\$2,989
BOND	0.00%					\$0
PROFIT	10.00%					\$2,989
JOB TOTAL						\$35,869



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Estimate:      BLDG 2970          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
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## SUMMARY

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=====
              Manhours   Matl     Labor   Equipment   Sub       Total
=====
U02 SITEWORK      206     $1,100   $4,744   $2,122       $0     $7,966
U15 MECHANICAL      1       $226     $12      $0     $21,687   $21,925
TOTAL              207     $1,326   $4,756   $2,122   $21,687   $29,891

SALES TAX          0.00%       $0
MATL MARKUP        0.00%       $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326   $4,756   $2,122   $21,687   $29,891
CONTINGENCY        10.00%      $2,989
BOND               0.00%       $0
PROFIT            10.00%      $2,989
JOB TOTAL                                     $35,869
=====

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Estimate:      BLDG 2970          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	220.00 L.F.	
Totals	97.68	\$917	\$2,267	\$0	\$0	14.47 \$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNGR SZD FOR CVRG 10'OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	340.00 L.F.	
Totals	43.18	\$558	\$978	\$0	\$0	4.52 \$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	
Totals	14.50	\$1,154	\$110	\$0	\$0	43.59 \$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	
Totals	3.00	\$738	\$120	\$0	\$0	858.50 \$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	
Totals	6.00	\$5,160	\$264	\$0	\$0	904.06 \$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	
Totals	6.00	\$1,065	\$163	\$0	\$0	1228.40 \$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	
Totals	16.00	\$3,740	\$327	\$0	\$0	1016.70 \$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	
Totals	8.00	\$350	\$382	\$0	\$0	146.50 \$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	
Totals	6.00	\$450	\$165	\$0	\$0	102.55 \$615

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      0.00      $402
U16 ELECTRICAL      3      $331      $71        $0        $0    $402
=====
```

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2970           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601          $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776          $0      $0     $18,908
U16 ELECTRICAL       3       $331       $71            $0      $0       $402
TOTAL              257     $15,239     $6,448          $0      $0     $21,687

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0

TOTAL BEFORE CONTINGENC $15,239     $6,448          $0      $0     $21,687
CONTINGENCY          0.00%          $0
BOND                 0.00%          $0
PROFIT               0.00%          $0

JOB TOTAL                                     $21,687

```

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=====
Estimate:      BLDG 2971      Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY   Job #:      94013.02
Sq. footage:   6900.00        City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24" THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00	226.16	
Totals	35.79	\$0	\$786	\$1,136	\$0	\$1,922	
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00	4.44	
Totals	60.00	\$0	\$1,262	\$514	\$0	\$1,776	
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values	0.11	0.00	2.35	1.01	0.00	3.36	
Totals	5.60	\$0	\$118	\$50	\$0	\$168	
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values	0.14	0.00	2.94	1.26	0.00	4.20	
Totals	21.00	\$0	\$441	\$190	\$0	\$631	
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00	380.36	
Totals	7.27	\$0	\$190	\$0	\$0	\$190	
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00	2.21	
Totals	14.20	\$0	\$395	\$47	\$0	\$442	
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00	6.23	
Totals	20.00	\$0	\$555	\$68	\$0	\$623	
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00	2.41	
Totals	1.42	\$0	\$28	\$11	\$0	\$39	
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253



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=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00      1.00 LS.
Totals           0.00      $0        $0        $0    21687.00  21687.00
                                           $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      1.00 Ea.
Totals           0.53    $226      $12        $0      0.00    238.10
                                           $0        $238
U15 MECHANICAL      1      $226      $12        $0    $21,687    $21,925

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=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====

ESTIMATE TOTAL      195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX            0.00%           $0
MATL MARKUP          0.00%           $0
LABOR MARKUP         0.00%           $0
EQUIPT MARKUP        0.00%           $0
SUB MARKUP           0.00%           $0

TOTAL BEFORE CONTINGENC  $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY          10.00%           $2,957
BOND                  0.00%           $0
PROFIT               10.00%           $2,957

JOB TOTAL                                     $35,480
=====
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18-Oct-94

MeansData for Lotus

Page 5

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=====
Estimate:      BLDG 2971      Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY  Job #:      94013.02
Sq. footage:   6900.00      City indx: Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	194	\$1,100	\$4,420	\$2,122	\$0	\$7,642
U15 MECHANICAL	1	\$226	\$12	\$0	\$21,687	\$21,925
TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2971          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASS Bid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx: Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	230.00 L.F.	
Totals		34.27	\$510	\$1,052	\$0	0.00	6.79
						\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	120.00 L.F.	
Totals		17.88	\$266	\$549	\$0	0.00	6.79
						\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					220.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
					340.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					29.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
					1.00 Ea.	
Unit values	6.00	1065.00	163.40	0.00	0.00	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
					4.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					5.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					6.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58        0.00        1.00 Ea.    401.34
Totals            2.96    $331      $71          $0        $0        $402

U16 ELECTRICAL      3      $331      $71          $0        $0        $402
```

```
=====
Line #      Description
-----
      Manhours   Matl     Labor   Equipment   Sub     Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2971           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3      $331       $71       $0      $0      $402
TOTAL              257     $15,239     $6,448      $0      $0     $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                     $21,687

```



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2970		BUILDING HEATING TEMPERATURE SETPOINT: 60 F				PAGE 1 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
		1 F					
		59 F					
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER	X	59	F TEMP DIFF	X	0.81 = 0.02 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR =		AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL =	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES						= 0.33 MBTU / HR	
						= 349.48 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2970		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					PAGE 2 OF 3						
		OUTSIDE DESIGN TEMPERATURE 1 F											
		TEMPERATURE DIFFERENCE 54 F											
INFILTRATION LOSSES =		1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES													
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR	
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR	
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR	
CLR SGL PANE WINDOWS =		0	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TINTED DBL PANE WIN'W =		485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR	
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR	
WOOD GLAZED O'HEAD DR =		0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
LG MTL SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F	TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES										=	0.30	MBTU / HR	
										=	319.86	MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2970	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	0.30	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	0.33	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)		\$4.62	
\$ /MBTU -FUEL OIL		\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
	1,036.66	MBTU/YR	X	CORR FACTOR	1						
ECO - 1 =	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X	CORR FACTOR	1						
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											
									=	528.21	MBTU/YR
									=	557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	6.6	\$ /MBTU	=	6,841.99	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								4,492.94
								\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2971		BUILDING HEATING TEMPERATURE SETPOINT: 60 F		PAGE 1 OF 3				
		OUTSIDE DESIGN TEMPERATURE		1 F				
		TEMPERATURE DIFFERENCE		59 F				
INFILTRATION LOSSES =	1	AIR CHGS X	114900	VOL (CU FT) X	59 F TEMP DIFF X 0.019 =	0.13	MBTU / HR	
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X		59 F TEMP DIFF X 0.81 =	0.02	MBTU / HR		
SURFACE HEAT LOSSES								
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TOTAL BASELINE HEAT LOSSES						=	0.33	MBTU / HR
						=	349.48	MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2971

BUILDING HEATING TEMPERATURE SETPOINT: 55 F  
OUTSIDE DESIGN TEMPERATURE 1 F  
TEMPERATURE DIFFERENCE 54 F

INFILTRATION LOSSES = 1 AIR CHGS X 114900 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.12 MBTU / HR

FLOOR LOSSES = 350 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF = 6900 AREA (SF) X 0.105 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR

FACE BRICK/BLK WALL = 0 AREA (SF) X 0.176 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

8" CINDER BLOCK WALL = 2936 AREA (SF) X 0.389 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR

CORR MTL PNL WALL = 1165 AREA (SF) X 0.17 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR

CLR SGL PANE WINDOWS = 0 AREA (SF) X 1.235 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

TINTED DBL PANE WIN'W = 485 AREA (SF) X 0.65 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR

METAL ROLL UP DOORS = 1344 AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR

WOOD GLAZED O'HEAD DR = 0 AREA (SF) X 0.214 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

LG MTL SLIDING DOOR = 0 AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

METAL PERSONNEL DR = 0 AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

MTL/ GLAZED PERSONNEL = 25 AREA (SF) X 0.615 U VALUE (BTU/HR - SF - F) X 54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.30 MBTU / HR  
= 319.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2971	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	ECO - 1		
OUTSIDE DESIGN TEMP (F)	60%	90%	
HTG TEMP SETPOINT (F)	1	55	1 MBTU = 1055 MJ
HEATING DEGREE DAYS	60	3396	0.019=CONSTANT
TOTAL HEAT LOSSES	4616	0.30	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
(MBTU / HR)	0.33	\$6.60	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
\$ /MBTU -FUEL OIL	\$6.60	\$4.62	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -NATURAL GAS	\$4.62	\$10.84	
\$ /MBTU -PPG	\$10.84		

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY				
	0.6	SYS EFF	X	59	TEMP DIFFERENCE				=	1,036.66	MBTU/YR	
ECO - 1 =	1,036.66	MBTU/YR	X		CORR FACTOR		1		=		1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY				
	0.9	SYS EFF	X	54	TEMP DIFFERENCE				=	508.45	MBTU/YR	
	508.45	MBTU/YR	X		CORR FACTOR		1		=		508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS											528.21	MBTU/YR
											557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	6.6	\$ /MBTU		=	6,841.99	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU		=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS									= 4,492.94 \$ /YR

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: 2958ECO1

LCCID 1.080

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT KNOX      REGION NOS. 4      CENSUS: 3

PROJECT NO. & TITLE: 2958ECO1      ECO-1 INFRARED HEAT

FISCAL YEAR 95      DISCRETE PORTION NAME: INFRARED

ANALYSIS DATE: 10-18-94      ECONOMIC LIFE 20 YEARS PREPARED BY: JAH

1. INVESTMENT

A. CONSTRUCTION COST	\$	219504.	
B. SIOH	\$	10975.	
C. DESIGN COST	\$	10975.	
D. TOTAL COST (1A+1B+1C)	\$	241454.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$		241454.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ .00	0.	\$ 0.	15.61	\$ 0.
B. DIST	\$ 6.60	0.	\$ 0.	17.56	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	19.97	\$ 0.
D. NAT G	\$ 4.62	3763.	\$ 17384.	20.96	\$ 364370.
E. COAL	\$ .00	0.	\$ 0.	17.58	\$ 0.
F. LPG	\$ .00	0.	\$ 0.	16.12	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.74	\$ 0.
N. TOTAL		3763.	\$ 17384.		\$ 364370.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A) 14.74 \$ 1980.

(2) DISCOUNTED SAVING/COST (3A X 3A1) \$ 29185.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
1. REPAIR	\$ 23952.	5	.86	20598.
2. REPAIR2	\$ 23952.	15	.63	15090.
3. REPAIR3	\$ 6423.	7	.81	5202.
4. REPAIR4	\$ 6423.	14	.65	4175.

d. TOTAL \$ 60749. 45065.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 74250.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 22401.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.78 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 438620.

7. SAVINGS TO INVESTMENT RATIO (SIR) =  $(6 / 1G) =$  1.82  
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.22 %

```

=====
Estimate:      BLDG 2958           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    *****          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4" DIAMETER					700.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		105.00	\$0	\$2,209	\$900	\$0	\$3,109
0207180380	HVAC DEMO, BOILER GAS/OIL STL >150MBH					1.00 Ea.	
Unit values		12.00	0.00	323.82	0.00	0.00	323.82
Totals		12.00	\$0	\$324	\$0	\$0	\$324
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					3.00 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		43.64	\$0	\$1,141	\$0	\$0	\$1,141
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					700.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		49.70	\$0	\$1,382	\$166	\$0	\$1,548
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					90.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		18.00	\$0	\$500	\$61	\$0	\$561
0268520600	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN END, TAR COAT&WRAP 2" DIAM					100.00 L.F.	
Unit values		0.11	2.19	3.18	0.19	0.00	5.55
Totals		11.40	\$219	\$318	\$19	\$0	\$556
U02 SITEWORK		240	\$219	\$5,874	\$1,146	\$0	\$7,239



```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====
1554510245   HTG INFA-RD UNT GAS ELEC IGN   (See Attached for Breakdown
                                     1.00 LS
Unit values      0.00      0.00      0.00      0.00  57414.00  57414.00
Totals           0.00      $0        $0        $0    $57,414  $57,414

U15 MECHANICAL      0        $0        $0        $0    $57,414  $57,414
```

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	240	\$219	\$5,874	\$1,146	\$57,414	\$64,653
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$219	\$5,874	\$1,146	\$57,414	\$64,653
CONTINGENCY	10.00%					\$6,465
BOND	0.00%					\$0
PROFIT	10.00%					\$6,465
JOB TOTAL						\$77,584

18-Oct-94

## MeansData for Lotus

Page 4

```

=====
Estimate:      BLDG 2958          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   *****          City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      240    $219    $5,874    $1,146    $0    $7,239
U15 MECHANICAL      0      $0      $0      $0    $57,414    $57,414
TOTAL              240    $219    $5,874    $1,146    $57,414    $64,653
SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0
TOTAL BEFORE CONTINGENC  $219    $5,874    $1,146    $57,414    $64,653
CONTINGENCY        10.00%      $0
BOND               0.00%      $0
PROFIT            10.00%      $0
JOB TOTAL                                     $6,465
                                           $77,584

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=====
Estimate:      BLDG 2958           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx: Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	930.00 L.F.	
Totals		138.57	\$2,061	\$4,252	\$0	\$0	6.79 \$6,313
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES						
Unit values		0.15	2.22	4.57	0.00	100.00 L.F.	
Totals		14.90	\$222	\$457	\$0	\$0	6.79 \$679
A09 ELECTRICAL		154	\$2,283	\$4,709	\$0	\$0	\$6,992

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					930.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	412.92	\$3,878	\$9,581	\$0	\$0	\$13,459
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
					1030.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	130.81	\$1,689	\$2,962	\$0	\$0	\$4,651
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					129.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	64.50	\$5,133	\$491	\$0	\$0	\$5,624
1524105040	VACUUM PUMP AND VENT PIPING					
					3.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	9.00	\$2,215	\$360	\$0	\$0	\$2,575
1552301020	GAS FIRED BURNER 100 MBH & COMBUSTION CHAMBER					
					18.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	18.00	\$15,480	\$793	\$0	\$0	\$16,273
1554510160	CO RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 40MBH					
					5.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	20.00	\$4,675	\$409	\$0	\$0	\$5,084
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					5.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					8.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	8.00	\$600	\$220	\$0	\$0	\$820
U15 MECHANICAL	672	\$34,020	\$15,198	\$0	\$0	\$49,218

```
=====
Line #      Description
-----
              Manhours   Matl      Labor   Equipment   Sub      Total
=====

1631200100  HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96      330.76      70.58      0.00      3.00 Ea.
Totals           8.89      $992        $212        $0        0.00      401.34
                                           $0        $0        $1,204

U16 ELECTRICAL      9      $992        $212        $0        $0      $1,204
```

```
=====
Line #      Description
-----
            Manhours   Matl      Labor   Equipment   Sub      Total
=====

ESTIMATE TOTAL      835    $37,295    $20,119          $0          $0    $57,414

SALES TAX            0.00%          $0
MATL MARKUP          0.00%          $0
LABOR MARKUP         0.00%          $0
EQUIPT MARKUP        0.00%          $0
SUB MARKUP           0.00%          $0

TOTAL BEFORE CONTINGENC $37,295    $20,119          $0          $0    $57,414
CONTINGENCY           0.00%          $0
BOND                  0.00%          $0
PROFIT                0.00%          $0

JOB TOTAL                                     $57,414
```

```

=====
Estimate:      BLDG 2958      Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY   Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL  154    $2,283    $4,709          $0    $0    $6,992
U15 MECHANICAL  672    $34,020   $15,198          $0    $0    $49,218
U16 ELECTRICAL   9      $992      $212          $0    $0    $1,204
TOTAL          835    $37,295   $20,119          $0    $0    $57,414
SALES TAX       0.00%          $0
MATL MARKUP     0.00%          $0
LABOR MARKUP    0.00%          $0
EQUIPT MARKUP   0.00%          $0
SUB MARKUP      0.00%          $Q
TOTAL BEFORE CONTINGENC $37,295   $20,119          $0    $0    $57,414
CONTINGENCY     0.00%
BOND            0.00%
PROFIT          0.00%
JOB TOTAL                                     $57,414

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=====
Estimate:      BLDG 2973          Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

18-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60- .					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
              Manhours  Matl      Labor  Equipment  Sub      Total
=====
U02 SITEWORK      194      $1,100    $4,420    $2,122        $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN  (See Attached for Breakdown
Unit values              0.00      0.00      0.00      0.00  1.00 LS.
Totals              0.00      $0      $0      $0  21687.00  21687.00
              0.00      $0      $0      $0  $21,687    $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
Unit values              0.53      226.00    12.10      0.00  1.00 Ea.
Totals              0.53      $226      $12      $0      0.00  238.10
              0.53      $226      $12      $0      $0    $238
U15 MECHANICAL      1      $226      $12      $0  $21,687    $21,925

```

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=====
Line #      Description
-----
           Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2973           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP (GLASSBid Date:
Location:      FORT KNOX, KY       Job #:      94013.02
Sq. footage:   6900.00           City indx: Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
U15 MECHANICAL      1      $226      $12      $0    $21,687    $21,925
TOTAL              195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC  $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY         10.00%      $2,957
BOND                 0.00%      $0
PROFIT              10.00%      $2,957
JOB TOTAL                                     $35,480

```

```

=====
Estimate:      BLDG 2973          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	220.00 L.F.	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG. & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	340.00 L.F.	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U15 MECHANICAL      201    $14,132    $4,776      $0      $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58      0.00      1.00 Ea.
Totals            2.96     $331     $71        $0      0.00    401.34
                        $0      $402
U16 ELECTRICAL      3      $331     $71        $0      $0    $402
=====
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18-Oct-94

MeansData for Lotus

Page 4

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=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

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=====
Estimate:      BLDG 2973          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601          $0      $0      $2,377
U15 MECHANICAL     201     $14,132      $4,776          $0      $0     $18,908
U16 ELECTRICAL       3       $331        $71            $0      $0       $402

TOTAL              257     $15,239      $6,448          $0      $0     $21,687

SALES TAX           0.00%          $0
MATL MARKUP         0.00%          $0
LABOR MARKUP        0.00%          $0
EQUIPT MARKUP       0.00%          $0
SUB MARKUP          0.00%          $0

TOTAL BEFORE CONTINGENC $15,239      $6,448          $0      $0     $21,687
CONTINGENCY          0.00%          $0
BOND                 0.00%          $0
PROFIT               0.00%          $0

JOB TOTAL                                $21,687

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=====
Estimate:      BLDG 2974      Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    6900.00      City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values	0.11	0.00	2.35	1.01	0.00		3.36
Totals	5.60	\$0	\$118	\$50	\$0		\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values	0.14	0.00	2.94	1.26	0.00		4.20
Totals	21.00	\$0	\$441	\$190	\$0		\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub      Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals            0.00      $0        $0        $0    $21,687  $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00    238.10
Totals            0.53    $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $21,687  $21,925
=====
```

=====

Line #	Description						
		Manhours	Matl	Labor	Equipment	Sub	Total
ESTIMATE TOTAL		195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%		\$0				
MATL MARKUP	0.00%		\$0				
LABOR MARKUP	0.00%			\$0			
EQUIPT MARKUP	0.00%				\$0		
SUB MARKUP	0.00%					\$0	
TOTAL BEFORE CONTINGENC			\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%						\$2,957
BOND	0.00%						\$0
PROFIT	10.00%						\$2,957
JOB TOTAL							\$35,480

```

=====
Estimate:      BLDG 2974           Date:      14-Oct-94
Description:   COST ESTIMATE
Project:       LIMITED EEAP(GLASSBid Date:
Location:      FORT KNOX, KY      Job #:      94013.02
Sq. footage:   6900.00           City indx:Louisville, KY
=====

```

## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
U15 MECHANICAL      1      $226      $12      $0    $21,687    $21,925
TOTAL              195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY        10.00%      $2,957
BOND               0.00%      $0
PROFIT            10.00%      $2,957
JOB TOTAL                                     $35,480

```

```

=====
Estimate:      BLDG 2974          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377



=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS 220.00 L.F.					
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM 340.00 L.F.					
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS 29.00 Ea.					
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING 1.00 Ea.					
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER 6.00 Ea.					
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH 1.00 Ea.					
Unit values	6.00	1065.00	163.40	0.00	0.00	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH 4.00 Ea.					
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE 5.00 Ea.					
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING 6.00 Ea.					
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      $0      $402

U16 ELECTRICAL      3      $331      $71      $0      $0      $402
```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2974      Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
A09 ELECTRICAL      53      $776      $1,601      $0      $0      $2,377
U15 MECHANICAL     201     $14,132     $4,776      $0      $0     $18,908
U16 ELECTRICAL       3      $331       $71      $0      $0      $402
TOTAL              257     $15,239     $6,448      $0      $0     $21,687

SALES TAX           0.00%      $0
MATL MARKUP         0.00%      $0
LABOR MARKUP        0.00%      $0
EQUIPT MARKUP       0.00%      $0
SUB MARKUP          0.00%      $0

TOTAL BEFORE CONTINGENC $15,239     $6,448      $0      $0     $21,687
CONTINGENCY          0.00%
BOND                 0.00%
PROFIT               0.00%

JOB TOTAL                                           $21,687

```

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=====
Estimate:      BLDG 2979          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values		4.21	0.00	92.52	133.64	0.00	226.16
Totals		35.79	\$0	\$786	\$1,136	\$0	\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values		0.15	0.00	3.16	1.29	0.00	4.44
Totals		60.00	\$0	\$1,262	\$514	\$0	\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values		0.11	0.00	2.35	1.01	0.00	3.36
Totals		5.60	\$0	\$118	\$50	\$0	\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values		0.14	0.00	2.94	1.26	0.00	4.20
Totals		21.00	\$0	\$441	\$190	\$0	\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values		14.55	0.00	380.36	0.00	0.00	380.36
Totals		7.27	\$0	\$190	\$0	\$0	\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values		0.07	0.00	1.97	0.24	0.00	2.21
Totals		14.20	\$0	\$395	\$47	\$0	\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values		0.20	0.00	5.55	0.68	0.00	6.23
Totals		20.00	\$0	\$555	\$68	\$0	\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values		0.09	0.00	1.74	0.67	0.00	2.41
Totals		1.42	\$0	\$28	\$11	\$0	\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					
Unit values	0.05	17.52	1.07	1.02	31.50 S.Y.	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					
Unit values	0.16	2.43	3.37	1.37	4.50 C.Y.	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
Unit values	0.09	0.00	1.74	0.67	4.50 C.Y.	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
Unit values	1.56	259.60	35.47	5.91	1.00 Ea.	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					
Unit values	0.07	0.75	1.48	0.00	240.00 L.F.	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					
Unit values	0.11	1.92	2.96	0.17	50.00 L.F.	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253

```

=====
Line #      Description
-----
            Manhours  Matl    Labor   Equipment   Sub      Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122        $0    $7,642
1554510245      HTG INFA-RD UNT GAS ELEC IGN (See Attached for Breakdown)
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687  $21,687
1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00  238.10
Totals           0.53    $226      $12        $0        $0    $238
U15 MECHANICAL      1      $226      $12        $0    $21,687  $21,925

```

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=====
Line #      Description
-----
            Manhours   Matl    Labor   Equipment   Sub      Total
=====
```

ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480



```

=====
Estimate:      BLDG 2979          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
U02 SITEWORK	194	\$1,100	\$4,420	\$2,122	\$0	\$7,642
U15 MECHANICAL	1	\$226	\$12	\$0	\$21,687	\$21,925
TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2979          Date:      14-Oct-94
Description:    INFRARED HEATING SYSTEM COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    City indx:Louisville, KY
=====

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Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
Unit values	0.44	4.17	10.30	0.00	220.00 L.F.	
Totals	97.68	\$917	\$2,267	\$0	\$0	14.47 \$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
Unit values	0.13	1.64	2.88	0.00	340.00 L.F.	
Totals	43.18	\$558	\$978	\$0	\$0	4.52 \$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
Unit values	0.50	39.79	3.80	0.00	29.00 Ea.	
Totals	14.50	\$1,154	\$110	\$0	\$0	43.59 \$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
Unit values	3.00	738.35	120.15	0.00	1.00 Ea.	
Totals	3.00	\$738	\$120	\$0	\$0	858.50 \$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
Unit values	1.00	860.00	44.06	0.00	6.00 Ea.	
Totals	6.00	\$5,160	\$264	\$0	\$0	904.06 \$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
Unit values	6.00	1065.00	163.40	0.00	1.00 Ea.	
Totals	6.00	\$1,065	\$163	\$0	\$0	1228.40 \$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
Unit values	4.00	935.00	81.70	0.00	4.00 Ea.	
Totals	16.00	\$3,740	\$327	\$0	\$0	1016.70 \$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
Unit values	1.60	70.00	76.50	0.00	5.00 Ea.	
Totals	8.00	\$350	\$382	\$0	\$0	146.50 \$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
Unit values	1.00	75.00	27.55	0.00	6.00 Ea.	
Totals	6.00	\$450	\$165	\$0	\$0	102.55 \$615

```
=====
Line #      Description
-----
      Manhours  Matl    Labor  Equipment  Sub    Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      0.00      $0    $402

U16 ELECTRICAL      3      $331      $71      $0        $0        $402
.
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18-Oct-94

## MeansData for Lotus

Page 4

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

18-Oct-94

MeansData for Lotus

Page 5

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=====
Estimate:      BLDG 2979           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP (GLASS Bid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:  City indx: Louisville, KY
=====

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## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	53	\$776	\$1,601	\$0	\$0	\$2,377
U15 MECHANICAL	201	\$14,132	\$4,776	\$0	\$0	\$18,908
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

```

=====
Estimate:      BLDG 2980          Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY     Job #:      94013.02
Sq. footage:    6900.00          City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0205542200	SITE DEMOLITION, PAVEMENT, CONCRETE, TO 24"THICK, REINFORCED					8.50 C.Y.	
Unit values	4.21	0.00	92.52	133.64	0.00		226.16
Totals	35.79	\$0	\$786	\$1,136	\$0		\$1,922
0205543200	SITE REMOVAL, STEEL PIPE, WELDED CONNECTION, 4"DIAMETER					400.00 L.F.	
Unit values	0.15	0.00	3.16	1.29	0.00		4.44
Totals	60.00	\$0	\$1,262	\$514	\$0		\$1,776
0207142000	FRAMING DEMO, STEEL BEAMS, 4" X 6"					50.00 L.F.	
Unit values	0.11	0.00	2.35	1.01	0.00		3.36
Totals	5.60	\$0	\$118	\$50	\$0		\$168
0207142200	FRAMING DEMO, STEEL COLUMNS, 6" X 6"					150.00 L.F.	
Unit values	0.14	0.00	2.94	1.26	0.00		4.20
Totals	21.00	\$0	\$441	\$190	\$0		\$631
0207183600	HVAC DEMO, MECH EQPT HEAVY ITEM					0.50 Ton	
Unit values	14.55	0.00	380.36	0.00	0.00		380.36
Totals	7.27	\$0	\$190	\$0	\$0		\$190
0208400600	REMOVE PIPE INSULATION UP TO 4" DIAMETER PIPE					200.00 L.F.	
Unit values	0.07	0.00	1.97	0.24	0.00		2.21
Totals	14.20	\$0	\$395	\$47	\$0		\$442
0208401000	REMOVE INSULATION FROM PIPE FITTING, UP TO 4" DIAMETER PIPE					100.00 Ea.	
Unit values	0.20	0.00	5.55	0.68	0.00		6.23
Totals	20.00	\$0	\$555	\$68	\$0		\$623
0222541900	TAMPING TRENCH B'FILL, VIBRATING PLATE, ADD					16.00 C.Y.	
Unit values	0.09	0.00	1.74	0.67	0.00		2.41
Totals	1.42	\$0	\$28	\$11	\$0		\$39
0222582800	TRENCH EXCVTNG 40HP CHNTRNCHR&BKFL 12"W24"D					210.00 L.F.	

18-Oct-94

## MeansData for Lotus

Page 2

Unit values	0.01	0.00	0.24	0.24	0.00	0.47
Totals	2.10	\$0	\$50	\$50	\$0	\$100
0251200400	CONCRETE PAVING, JOINTS/FINISH, 4500 PSI					
	CONCRETE, 12" THICK					31.50 S.Y.
Unit values	0.05	17.52	1.07	1.02	0.00	19.61
Totals	1.54	\$552	\$34	\$32	\$0	\$618
0260120200	BEDDING, FOR PIPE IN TRENCH SAND, DEAD OR					
	BANK					4.50 C.Y.
Unit values	0.16	2.43	3.37	1.37	0.00	7.17
Totals	0.72	\$11	\$15	\$6	\$0	\$32
0260120500	BEDDING, PLACING IN TRENCH					
						4.50 C.Y.
Unit values	0.09	0.00	1.74	0.67	0.00	2.41
Totals	0.40	\$0	\$8	\$3	\$0	\$11
0266907800	CUT IN VALVES, W/DUCK TIP GASKET, 4" DIAMETER					
						1.00 Ea.
Unit values	1.56	259.60	35.47	5.91	0.00	300.98
Totals	1.56	\$260	\$35	\$6	\$0	\$301
0268520200	GAS SERVICE & DISTRIB PIPING, POLYETHYLENE, 60-					
	PSI 2" DIAM COIL SDR 11					240.00 L.F.
Unit values	0.07	0.75	1.48	0.00	0.00	2.23
Totals	16.08	\$181	\$355	\$0	\$0	\$536
0268520550	GAS SERVICE&DISTRIB PIPING, SCH40 STEEL PLAIN					
	END, TAR COAT&WRAP 1"DIAM					50.00 L.F.
Unit values	0.11	1.92	2.96	0.17	0.00	5.06
Totals	5.35	\$96	\$148	\$9	\$0	\$253



```

=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub    Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642

1554510245      HTG INFA-RD UNT GAS ELEC IGN  A(See Attached for Breakdow
                                     1.00 LS.
Unit values      0.00      0.00      0.00      0.00  21687.00  21687.00
Totals           0.00      $0        $0        $0    $21,687  $21,687

1562600137      GAS APPLIANCE REGULATORS DOUBLE DIAPHRAGM
TYPE 1-1/4" PIPE SIZE
Unit values      0.53    226.00    12.10      0.00      0.00  238.10
Totals           0.53    $226      $12        $0        $0    $238

U15 MECHANICAL      1      $226      $12        $0    $21,687  $21,925

```

```
=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	195	\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$1,326	\$4,432	\$2,122	\$21,687	\$29,567
CONTINGENCY	10.00%					\$2,957
BOND	0.00%					\$0
PROFIT	10.00%					\$2,957
JOB TOTAL						\$35,480

```

=====
Estimate:      BLDG 2980           Date:      14-Oct-94
Description:    COST ESTIMATE
Project:        LIMITED EEAP(GLASSBid Date:
Location:       FORT KNOX, KY      Job #:      94013.02
Sq. footage:    6900.00           City indx:Louisville, KY
=====

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## SUMMARY

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-----
Manhours  Matl  Labor  Equipment  Sub  Total
=====
U02 SITEWORK      194    $1,100    $4,420    $2,122      $0    $7,642
U15 MECHANICAL      1      $226      $12      $0    $21,687    $21,925
TOTAL              195    $1,326    $4,432    $2,122    $21,687    $29,567

SALES TAX          0.00%      $0
MATL MARKUP        0.00%      $0
LABOR MARKUP       0.00%      $0
EQUIPT MARKUP      0.00%      $0
SUB MARKUP         0.00%      $0

TOTAL BEFORE CONTINGENC $1,326    $4,432    $2,122    $21,687    $29,567
CONTINGENCY        10.00%      $2,957
BOND               0.00%      $0
PROFIT            10.00%      $2,957
JOB TOTAL                                     $35,480

```

```

=====
Estimate:      BLDG 2980          Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY      Job #:      94013.02
Sq. footage:   City indx:Louisville, KY
=====

```

Line #	Description	Manhours	Matl	Labor	Equipment	Sub	Total
0913100200	115V, 20 AMP POWER WIRING INCL CONDUIT, WIRE, AND RECEPTACLES					230.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		34.27	\$510	\$1,052	\$0	\$0	\$1,562
0913100200	CO-RAY-VAC VANTAGE 2 POWER FEEDER INSTALLATION, INCL CONDUIT, WIRE, AND RECEPTACLES					120.00 L.F.	
Unit values		0.15	2.22	4.57	0.00	0.00	6.79
Totals		17.88	\$266	\$549	\$0	\$0	\$815
A09 ELECTRICAL		53	\$776	\$1,601	\$0	\$0	\$2,377

=====						
Line #	Description					
	Manhours	Matl	Labor	Equipment	Sub	Total
=====						
1517010650	BLACK STEEL RADIANT PIPE, SCHEDULE 40, THREADED, 4" DIAM W/CPLGS					
					220.00 L.F.	
Unit values	0.44	4.17	10.30	0.00	0.00	14.47
Totals	97.68	\$917	\$2,267	\$0	\$0	\$3,184
1517011310	GAS SERVICE PIPE STEEL GALV SCH 40 THRD W/CPLG & HNCR SZD FOR CVRG 10' OC 1/2" DIAM					
					340.00 L.F.	
Unit values	0.13	1.64	2.88	0.00	0.00	4.52
Totals	43.18	\$558	\$978	\$0	\$0	\$1,536
1519010320	ALUMINUM REFLECTORS W/HANGERS					
					29.00 Ea.	
Unit values	0.50	39.79	3.80	0.00	0.00	43.59
Totals	14.50	\$1,154	\$110	\$0	\$0	\$1,264
1524105040	VACUUM PUMP AND VENT PIPING					
					1.00 Ea.	
Unit values	3.00	738.35	120.15	0.00	0.00	858.50
Totals	3.00	\$738	\$120	\$0	\$0	\$858
1552301020	CRV-90 GAS FIRED BURNER, 90 MBH & COMBUSTION CHAMBER					
					6.00 Ea.	
Unit values	1.00	860.00	44.06	0.00	0.00	904.06
Totals	6.00	\$5,160	\$264	\$0	\$0	\$5,424
1554510160	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNT, GAS 100MBH					
					1.00 Ea.	
Unit values	6.00	1065.00	163.40	0.00	0.00	1228.40
Totals	6.00	\$1,065	\$163	\$0	\$0	\$1,228
1554510220	CO-RAY-VAC VANTAGE 2 INFA-RD HTG UNIT, GAS 40 MBH					
					4.00 Ea.	
Unit values	4.00	935.00	81.70	0.00	0.00	1016.70
Totals	16.00	\$3,740	\$327	\$0	\$0	\$4,067
1556800120	CO-RAY-VAC VANTAGE 2 VENT PIPE					
					5.00 Ea.	
Unit values	1.60	70.00	76.50	0.00	0.00	146.50
Totals	8.00	\$350	\$382	\$0	\$0	\$732
1574205220	ELECTRIC THERMOSTAT W/ COVER AND WIRING					
					6.00 Ea.	
Unit values	1.00	75.00	27.55	0.00	0.00	102.55
Totals	6.00	\$450	\$165	\$0	\$0	\$615

```
=====
Line #      Description
-----
            Manhours  Matl    Labor  Equipment  Sub      Total
=====
U15 MECHANICAL      201    $14,132    $4,776        $0        $0    $18,908
1631200100    HEATING SYSTEM POWER / CONTROL PANEL
Unit values      2.96    330.76    70.58    0.00    1.00 Ea.    401.34
Totals            2.96    $331      $71      $0      $0      $402

U16 ELECTRICAL      3      $331      $71      $0      $0      $402
=====
```

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=====
Line #      Description
-----
      Manhours   Matl    Labor   Equipment   Sub    Total
=====
```

ESTIMATE TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687

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=====
Estimate:      BLDG 2980           Date:      14-Oct-94
Description:   INFRARED HEATING SYSTEM COST ESTIMATE
Project:      LIMITED EEAP(GLASSBid Date:
Location:     FORT KNOX, KY       Job #:      94013.02
Sq. footage:                      City indx:Louisville, KY
=====

```

## SUMMARY

	Manhours	Matl	Labor	Equipment	Sub	Total
A09 ELECTRICAL	53	\$776	\$1,601	\$0	\$0	\$2,377
U15 MECHANICAL	201	\$14,132	\$4,776	\$0	\$0	\$18,908
U16 ELECTRICAL	3	\$331	\$71	\$0	\$0	\$402
TOTAL	257	\$15,239	\$6,448	\$0	\$0	\$21,687
SALES TAX	0.00%	\$0				
MATL MARKUP	0.00%	\$0				
LABOR MARKUP	0.00%		\$0			
EQUIPT MARKUP	0.00%			\$0		
SUB MARKUP	0.00%				\$0	
TOTAL BEFORE CONTINGENC		\$15,239	\$6,448	\$0	\$0	\$21,687
CONTINGENCY	0.00%					\$0
BOND	0.00%					\$0
PROFIT	0.00%					\$0
JOB TOTAL						\$21,687



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		2958		BUILDING HEATING TEMPERATURE SETPOINT: OUTSIDE DESIGN TEMPERATURE TEMPERATURE DIFFERENCE					66 F 1 F 65 F		PAGE 1 OF 3					
INFILTRATION LOSSES =				1	AIR CHGS	X	427220	VOL (CU FT)	X	65	F TEMP DIFF	X 0.019	=	0.53	MBTU / HR	
FLOOR LOSSES =				828	LINEAR FEET OF PERIMETER					X	65	F TEMP DIFF	X 0.81	=	0.04	MBTU / HR
SURFACE HEAT LOSSES																
FLAT BUILT UP ROOF =				20270	AREA (SF)	X	0.105	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.14	MBTU / HR		
FACE BRICK/BLK WALL =					AREA (SF)	X	0.176	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =				3688	AREA (SF)	X	0.136	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR		
CORR MTL PNL WALL =				7090	AREA (SF)	X	0.17	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.08	MBTU / HR		
CLR SGL PANE WINDOWS =				836	AREA (SF)	X	1.235	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR		
TINTED DBL PANE WIN"W =				1028	AREA (SF)	X	0.65	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
METAL ROLL UP DOORS =				5600	AREA (SF)	X	0.56	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.20	MBTU / HR		
WOOD GLAZED O'HEAD DR =					AREA (SF)	X	0.583	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =					AREA (SF)	X	0.56	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=					AREA (SF)	X	0.56	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=				125	AREA (SF)	X	0.615	U VALUE (BTU/ HR - SF - F)	X	65	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TOTAL BASELINE HEAT LOSSES												=	1.14	MBTU / HR		
												=	1,202.57	MJ/HR		

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2958

BUILDING HEATING TEMPERATURE SETPOINT: 55 F

OUTSIDE DESIGN TEMPERATURE

1 F

TEMPERATURE DIFFERENCE

54 F

INFILTRATION LOSSES = 1 AIR CHGS X 427220 VOL (CU FT) X 54 F TEMP DIFF X 0.019 = 0.44 MBTU / HR

FLOOR LOSSES = 828 LINEAR FEET OF PERIMETER X 54 F TEMP DIFF X 0.81 = 0.04 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	20270	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.11	MBTU / HR
FACE BRICK/BLK WALL =	0	AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	3688	AREA (SF) X	0.136	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.03	MBTU / HR
CORR MTL PNL WALL =	7090	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
CLR SGL PANE WINDOWS =	836	AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR
TINTED DBL PANE WIN'W =	1028	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
METAL ROLL UP DOORS =	5600	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.17	MBTU / HR
WOOD GLAZED O'HEAD DR =	0	AREA (SF) X	0.583	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR=	0	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL=	125	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	54	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL ECO HEAT LOSSES

= 0.95 MBTU / HR

= 999.06 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2958	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.019=CONSTANT
HTG TEMP SETPOINT (F)	66	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	0.95	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	1.14	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)		\$4.62	
\$ /MBTU -FUEL OIL		\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	1.14	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	3,237.96	MBTU/YR
	0.6	SYS EFF	X	65	TEMP DIFFERENCE						
	3,237.96	MBTU/YR	X		CORR FACTOR	1			=	3,237.96	MBTU/YR
ECO - 1 =	0.95	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	1,588.12	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	1,588.12	MBTU/YR	X		CORR FACTOR	1			=	1,588.12	MBTU/YR
ECO - 1	ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=							=	1,649.84	MBTU/YR
										1,740,586.00	MJ/YR

## ANNUAL HEATING ENERGY COST

BASLINE =	3,237.96	MBTU / YR	X	4.62	\$ /MBTU	=	14,959.38	\$ /YR
ECO - 1 =	1,588.12	MBTU / YR	X	4.62	\$ /MBTU	=	7,337.09	\$ /YR
ECO - 1	ANNUAL HEATING ENERGY COST SAVINGS	=					7,622.28	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER:		2973		BUILDING HEATING TEMPERATURE SETPOINT:					60 F		PAGE 1 OF 3	
				OUTSIDE DESIGN TEMPERATURE					1 F			
				TEMPERATURE DIFFERENCE					59 F			
INFILTRATION LOSSES =		1	AIR CHGS	X	114900	VOL (CU FT)	X	59	F TEMP DIFF	X	0.019	= 0.13 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER		X	59	F TEMP DIFF	X	0.81	= 0.02 MBTU / HR		
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR		
FACE BRICK/BLK WALL =			AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.07 MBTU / HR		
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR		
CLR SGL PANE WINDOWS =			AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
TINTED DBL PANE WIN'W =		485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR		
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR		
METAL GLAZED O'HEAD DR =			AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
LG MTL SLIDING DOOR =			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
METAL PERSONNEL DR=			AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	59	F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR		
TOTAL BASELINE HEAT LOSSES											= 0.33 MBTU / HR	
											= 349.48 MJ/HR	

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING NUMBER: 2973		BUILDING HEATING TEMPERATURE SETPOINT: 55 F				PAGE 2 OF 3	
		OUTSIDE DESIGN TEMPERATURE					
		TEMPERATURE DIFFERENCE					
INFILTRATION LOSSES =		1	AIR CHGS	X 114900	VOL (CU FT)	X 54 F TEMP DIFF	X 0.019 = 0.12 MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER	X	54 F TEMP DIFF	X 0.81 = 0.02 MBTU / HR	
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.06 MBTU / HR
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		0	AREA (SF)	X	1.235	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TINTED DBL PANE WIN'W =		485	AREA (SF)	X	0.65	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
WOOD GLAZED O'HEAD DR =		0	AREA (SF)	X	0.214	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		0	AREA (SF)	X	0.56	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR-SF-F) X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL ECO HEAT LOSSES							= 0.30 MBTU / HR
							= 319.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BASELINE	ECO - 1
SYSTEM EFFICIENCY	60%	90%
OUTSIDE DESIGN TEMP (F)	1	1
HTG TEMP SETPOINT (F)	60	55
HEATING DEGREE DAYS	4616	3396
TOTAL HEAT LOSSES (MBTU / HR)	0.33	0.30
\$ /MBTU -FUEL OIL	\$6.60	\$6.60
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62
\$ /MBTU -PPG	\$10.84	\$10.84

BUILDING NUMBER 2973

GLOSSARY OF TERMS

1 MBTU = 1055 MJ  
 0.019=CONSTANT  
 .81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE  
 CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS  
 65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,036.66	MBTU/YR	X		CORR FACTOR		1		=	1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X		CORR FACTOR		1		=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS =											528.21
											557,265.71
											MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	4.62	\$ /MBTU	=	4,789.39	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								2,440.35
								\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3

BUILDING NUMBER: 2974 BUILDING HEATING TEMPERATURE SETPOINT: 60 F  
 OUTSIDE DESIGN TEMPERATURE 1 F  
 TEMPERATURE DIFFERENCE 59 F

INFILTRATION LOSSES = 1 AIR CHGS X 114900 VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR  
 FLOOR LOSSES = 350 LINEAR FEET OF PERIMETER X 59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR

### SURFACE HEAT LOSSES

FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.07	MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
METAL PERSONNEL DR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR
MTL/ GLAZED PERSONNEL =	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X	59	F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR

### TOTAL BASELINE HEAT LOSSES

= 0.33 MBTU / HR  
 = 349.48 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

BUILDING HEATING TEMPERATURE SETPOINT: 55 F										PAGE 2 OF 3		
BUILDING NUMBER: 2974		OUTSIDE DESIGN TEMPERATURE								1 F		
		TEMPERATURE DIFFERENCE								54 F		
INFILTRATION LOSSES =		1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X 0.019	=	0.12	MBTU / HR
FLOOR LOSSES =		350	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X 0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =		6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR	
FACE BRICK/BLK WALL =		0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
8" CINDER BLOCK WALL =		2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR	
CORR MTL PNL WALL =		1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR	
CLR SGL PANE WINDOWS =		0	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TINTED DBL PANE WIN'W =		485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR	
METAL ROLL UP DOORS =		1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR	
WOOD GLAZED O'HEAD DR =		0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
LG MTL SLIDING DOOR =		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
METAL PERSONNEL DR=		0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
MTL/ GLAZED PERSONNEL=		25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR	
TOTAL ECO HEAT LOSSES										=	0.30	MBTU / HR
										=	319.86	MJ/HR



# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2974	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	ECO - 1	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	60%	1	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	55	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	3396	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES	0.33	0.30	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
(MBTU / HR)			
\$ /MBTU -FUEL OIL	\$6.60	\$6.60	
\$ /MBTU -NATURAL GAS	\$4.62	\$4.62	
\$ /MBTU -PPG	\$10.84	\$10.84	

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
	1,036.66	MBTU/YR	X		CORR FACTOR	1			=	1,036.66	MBTU/YR
ECO - 1 =	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X		CORR FACTOR	1			=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	528.21	MBTU/YR
										557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	4.62	\$ /MBTU	=	4,789.39	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	2,440.35	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3

BUILDING NUMBER:	2979	BUILDING HEATING TEMPERATURE SETPOINT:	60 F
		OUTSIDE DESIGN TEMPERATURE	1 F
		TEMPERATURE DIFFERENCE	59 F
INFILTRATION LOSSES =	1	AIR CHGS X 114900 VOL (CU FT) X 59 F TEMP DIFF X 0.019	= 0.13 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X 59 F TEMP DIFF X 0.81	= 0.02 MBTU / HR
SURFACE HEAT LOSSES			
FLAT BUILT UP ROOF =	6900	AREA (SF) X 0.105 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X 0.176 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X 0.389 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X 0.17 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X 1.235 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TINTED DBL PANE WIN'W =	485	AREA (SF) X 0.65 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.02 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X 0.214 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X 0.56 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X 0.615 U VALUE (BTU/HR - SF - F) X 59 F TEMPERATURE DIFFERENCE	= 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES			= 0.33 MBTU / HR
			= 349.48 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2979		BUILDING HEATING TEMPERATURE SETPOINT: 55 F										
		OUTSIDE DESIGN TEMPERATURE 1 F										
		TEMPERATURE DIFFERENCE 54 F										
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF	X	0.019	=	0.12	MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER		X	54 F TEMP DIFF	X	0.81	=	0.02	MBTU / HR		
SURFACE HEAT LOSSES												
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
FACE BRICK/BLK WALL =	0	AREA (SF)	X	0.176	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
8" CINDER BLOCK WALL =	2936	AREA (SF)	X	0.389	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.06	MBTU / HR		
CORR MTL PNL WALL =	1165	AREA (SF)	X	0.17	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.01	MBTU / HR		
CLR SGL PANE WINDOWS =	0	AREA (SF)	X	1.235	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
TINTED DBL PANE WIN'W =	485	AREA (SF)	X	0.65	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.02	MBTU / HR		
METAL ROLL UP DOORS =	1344	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.04	MBTU / HR		
WOOD GLAZED O'HEAD DR =	0	AREA (SF)	X	0.214	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
LG MTL SLIDING DOOR =	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
METAL PERSONNEL DR=	0	AREA (SF)	X	0.56	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		
MTL/ GLAZED PERSONNEL=	25	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE	=	0.00	MBTU / HR		

### TOTAL ECO HEAT LOSSES

= 0.30 MBTU / HR  
= 319.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2979	GLOSSARY OF TERMS
SYSTEM EFFICIENCY	60%	90%	1 MBTU = 1055 MJ
OUTSIDE DESIGN TEMP (F)	1	55	0.019=CONSTANT
HTG TEMP SETPOINT (F)	60	3396	.81 = CONSTANT FOR SLAB PERIMETER UNINSULATED FROM ASHRAE
HEATING DEGREE DAYS	4616	0.30	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.33	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$4.62	\$10.84	
\$ /MBTU -NATURAL GAS			
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASELINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
ECO - 1 =	1,036.66	MBTU/YR	X	CORR FACTOR	1				=	1,036.66	MBTU/YR
	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X	CORR FACTOR	1				=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS	=								=	528.21	MBTU/YR
										557,265.71	MJ/YR

## ANNUAL HEATING ENERGY COST

BASELINE =	1,036.66	MBTU / YR	X	4.62	\$ /MBTU	=	4,789.39	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS	=					=	2,440.35	\$ /YR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 1 OF 3

BUILDING NUMBER:	2980	BUILDING HEATING TEMPERATURE SETPOINT:	60 F	
		OUTSIDE DESIGN TEMPERATURE	1 F	
		TEMPERATURE DIFFERENCE	59 F	
INFILTRATION LOSSES =	1	AIR CHGS X	114900	VOL (CU FT) X 59 F TEMP DIFF X 0.019 = 0.13 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER X	59 F TEMP DIFF X 0.81 = 0.02 MBTU / HR	
SURFACE HEAT LOSSES				
FLAT BUILT UP ROOF =	6900	AREA (SF) X	0.105	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
FACE BRICK/BLK WALL =		AREA (SF) X	0.176	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
8" CINDER BLOCK WALL =	2936	AREA (SF) X	0.389	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.07 MBTU / HR
CORR MTL PNL WALL =	1165	AREA (SF) X	0.17	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.01 MBTU / HR
CLR SGL PANE WINDOWS =		AREA (SF) X	1.235	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TINTED DBL PANE WIN"W =	485	AREA (SF) X	0.65	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.02 MBTU / HR
METAL ROLL UP DOORS =	1344	AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
METAL GLAZED O'HEAD DR =		AREA (SF) X	0.214	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
LG MTL SLIDING DOOR =		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
METAL PERSONNEL DR=		AREA (SF) X	0.56	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
MTL/ GLAZED PERSONNEL=	25	AREA (SF) X	0.615	U VALUE (BTU/HR - SF - F) X F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL BASELINE HEAT LOSSES				= 0.33 MBTU / HR
				= 349.48 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 2 OF 3

BUILDING NUMBER: 2980		BUILDING HEATING TEMPERATURE SETPOINT: 55 F					
		OUTSIDE DESIGN TEMPERATURE		1 F			
		TEMPERATURE DIFFERENCE		54 F			
INFILTRATION LOSSES =	1	AIR CHGS	X	114900	VOL (CU FT)	X	54 F TEMP DIFF X 0.019 = 0.12 MBTU / HR
FLOOR LOSSES =	350	LINEAR FEET OF PERIMETER	X	54	F TEMP DIFF	X	0.81 = 0.02 MBTU / HR
SURFACE HEAT LOSSES							
FLAT BUILT UP ROOF =	6900	AREA (SF)	X	0.105	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.04 MBTU / HR
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MTL/ GLAZED PERSONNEL =	25.	AREA (SF)	X	0.615	U VALUE (BTU/HR - SF - F)	X	54 F TEMPERATURE DIFFERENCE = 0.00 MBTU / HR
TOTAL ECO HEAT LOSSES							= 0.30 MBTU / HR
							= 319.86 MJ/HR

# FT KNOX LIMITED EEAP (GLASS)

## ECO - 1: INFRARED HEATING CALCULATIONS

PAGE 3 OF 3

	BUILDING NUMBER	2980	GLOSSARY OF TERMS
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HEATING DEGREE DAYS	4616	0.30	CORR FACTOR = EMPIRICAL CORRECTION FACTOR FOR HEATING EFFECT VS
TOTAL HEAT LOSSES (MBTU / HR)	0.33	\$6.60	65 F DEGREE-DAYS FROM ASHRAE FUNDAMENTALS 1989 PG28.2
\$ /MBTU -FUEL OIL	\$4.62	\$10.84	
\$ /MBTU -NATURAL GAS	\$10.84		
\$ /MBTU -PPG			

## ANNUAL HEATING ENERGY CONSUMPTION (DEGREE DAY METHOD)

BASLINE =	0.33	MBTU / HR	X	4616	DEGREE DAYS	X	24	HRS/DAY	=	1,036.66	MBTU/YR
	0.6	SYS EFF	X	59	TEMP DIFFERENCE						
	1,036.66	MBTU/YR	X		CORR FACTOR	1			=	1,036.66	MBTU/YR
ECO - 1 =	0.30	MBTU / HR	X	3396	DEGREE DAYS	X	24	HRS/DAY	=	508.45	MBTU/YR
	0.9	SYS EFF	X	54	TEMP DIFFERENCE						
	508.45	MBTU/YR	X		CORR FACTOR	1			=	508.45	MBTU/YR
ECO - 1 ANNUAL HEATING ENERGY CONSUMPTION SAVINGS =											528.21
											557,265.71
											MJ/YR

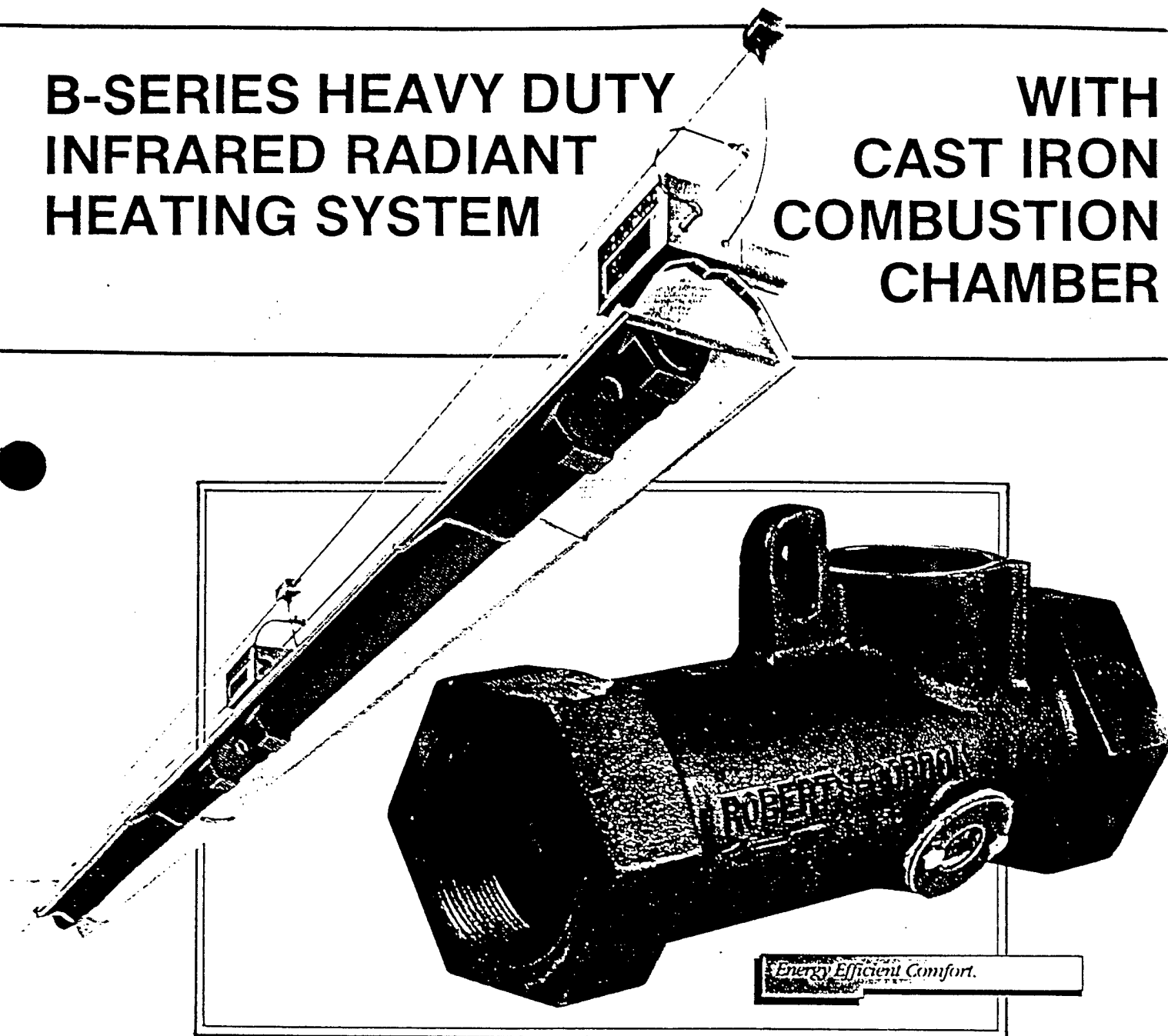
## ANNUAL HEATING ENERGY COST

BASLINE =	1,036.66	MBTU / YR	X	4.62	\$ /MBTU	=	4,789.39	\$ /YR
ECO - 1 =	508.45	MBTU / YR	X	4.62	\$ /MBTU	=	2,349.04	\$ /YR
ECO - 1 ANNUAL HEATING ENERGY COST SAVINGS =								2,440.35
								\$ /YR

# CO-RAY-VAC<sup>®</sup> CLASSIC

**B-SERIES HEAVY DUTY  
INFRARED RADIANT  
HEATING SYSTEM**

**WITH  
CAST IRON  
COMBUSTION  
CHAMBER**



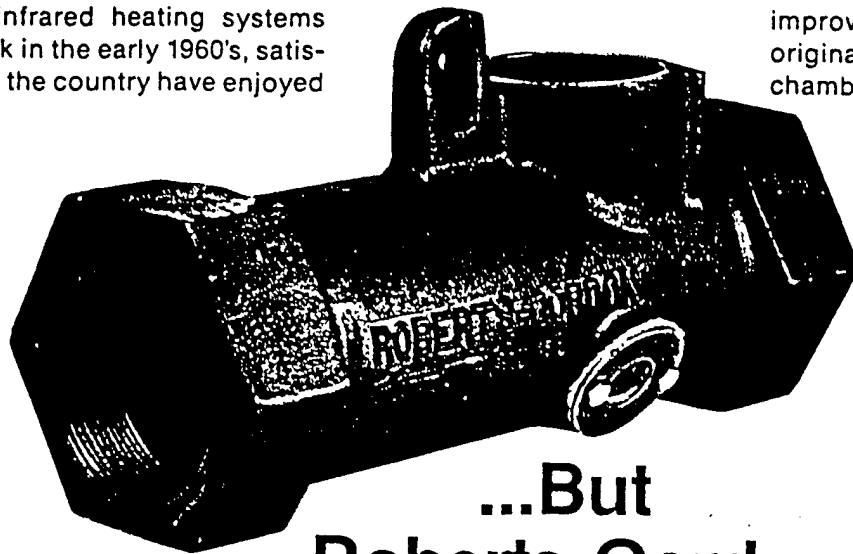
**CO-RAY-VAC "Classic" B-Series Heavy Duty Systems Feature Cast Iron Combustion Chambers, Burners, Vacuum Pump Housing & Schedule 40 Pipe to Combine "Built Like They Used To" Durability with the Latest in Modern Gas Combustion Technology.**



**15-YEAR  
WARRANTY\***

## Everyone Says, "They Don't Build Them Like They Used To..."

Since CO-RAY-VAC infrared heating systems were first installed back in the early 1960's, satisfied customers around the country have enjoyed years of trouble-free operation with our heavy duty cast iron heating systems. Everyone says, "They don't build them like they used to,"...But Roberts-Gordon does. CO-RAY-VAC heavy duty systems are still available today. They feature all the modern

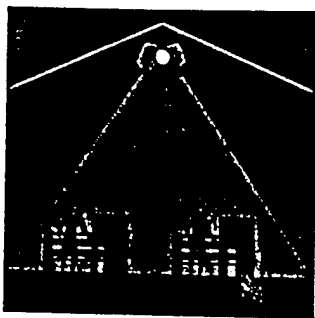
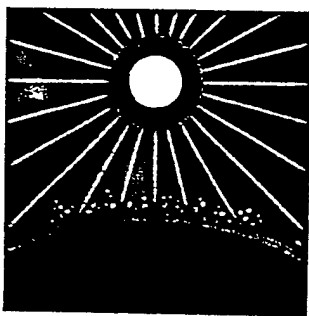


improvements, but keep the original cast iron combustion chamber, burners and vacuum pump housing for rugged durability and top performance year after year. Offered exclusively by Roberts-Gordon, the CO-RAY-VAC "Classic" heavy duty series is especially suited for installations where an extended lifetime of trouble-free service is desired.

### ...But Roberts-Gordon Does!

\* Roberts-Gordon cast iron combustion chambers and vacuum pump housing are warranted for 15 years against manufacturing defects and defects in workmanship.

## CO-RAY-VAC Gas-Fired, Fully Vented, Low-Intensity Radiant Heating System



### How Infrared Heating Works

High-efficiency CO-RAY-VAC heating systems warm the workplace in the same manner as the sun heats the earth. Like the sun, CO-RAY-VAC produces infrared rays. These low-intensity rays are directed downward by specially designed reflectors to spread a draftless blanket of warmth that heats the floor, people and objects directly. The warm floor and objects then release heat to warm the air. Since solid objects, not the air, are heated directly, people are comfortable at lower building thermostat settings.

### Outstanding Efficiency, Comfort and Savings

Design-Certified by the American Gas Association.

Outstanding Energy Efficiency—Independently tested Annual Fuel Utilization (AFUE) rating of 90.43%.

Fuel Cost Savings—Customers document savings up to 50% and more on their annual heating costs.

Low Maintenance—Cast iron combustion chambers, burners & vacuum pump housings are especially designed for trouble-free service.

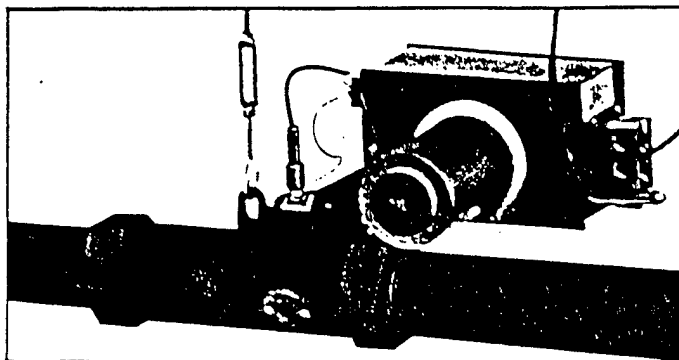
Clean, Quiet, Draft-Free, Uniform Heat—CO-RAY-VAC spreads heat evenly over large areas without noise, drafts or blasts of hot air. No swirling dust or grit, and no interference with your operations.

Greater Worker Comfort & Productivity—Because of the principle of CO-RAY-VAC infrared heating, employees are more comfortable in more favorable conditions. This can boost morale and productivity!

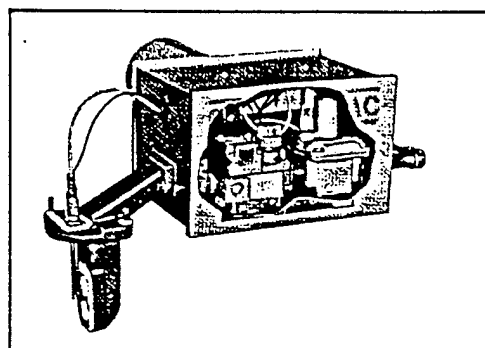
Faster Heat Recovery—Floor and objects act as heat reservoirs, giving off heat and providing fast heat recovery when large doors are closed.

# These are the features of the CO-RAY-VAC Heavy Duty Systems...

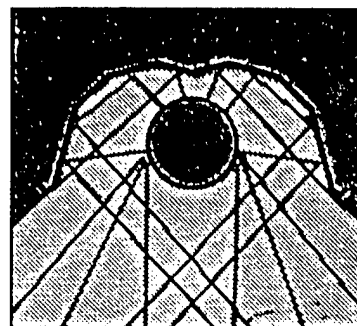
- Burners in series; wide range of inputs from 20,000 to 120,000 BTU for high and low mounting heights.



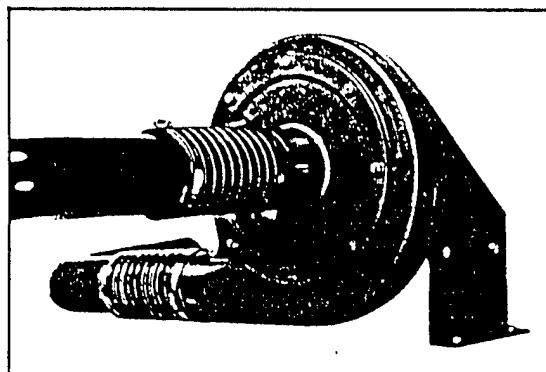
- Heavy duty cast iron combustion chamber for durability and long life.



- Cast iron burner and modern direct spark electronic ignition systems eliminate standing pilots and are compatible with state-of-the-art temperature control systems.



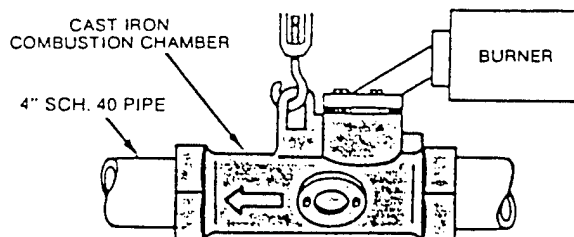
- Deep dish reflectors and perimeter reflectors maximize radiant output in all types of buildings.



- Totally enclosed vacuum pump motor for superior, trouble-free operation even in the most severe building environments.
- Can be suspended up to 60 ft. or more from the floor to clear gantry cranes, high rising equipment, etc.
- Fully vented, uses natural or propane gas.

## CO-RAY-VAC Heavy Duty Systems

Similar to standard CO-RAY-VAC system, but standard steel combustion chamber and standard radiant tube replaced with cast iron combustion chamber and schedule 40 steel radiant pipe.



### SPECIFICATIONS

MODEL	CRV-B2	CRV-B4	CRV-B6	CRV-B8	CRV-B10	CRV-B12
GAS INPUT, BTU/HR.	20,000	40,000	60,000	80,000	100,000	120,000

### CLEARANCES TO COMBUSTIBLES WITH STANDARD REFLECTOR

ABOVE	4"	4"	4"	4"	4"	4"
BELOW	48"	48"	48"	48"	60"	60"
SIDE	20"	20"	20"	20"	36"	36"

# Here are just a few installations Nationwide in which CO-RAY-VAC Heavy Duty Cast Iron Combustion Chambers have

## provided dependable service for 15 years or more.

Marplex Products Co., Inc.

June 9, 1987

Mr. Harold Steineke  
Wisconsin Instrument & Control, Inc.  
3196 N. Main Street  
Oshkosh, WI 54901

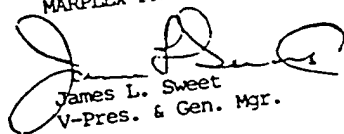
Dear Mr. Steineke:

It is interesting to discover that Marplex's  
Co-Ray-Vac heating system was the first  
installation in Wisconsin and also one of the  
first in the country.

I am pleased to advise you that our system  
works very well even after 25 years.  
Our maintenance is minimal and we are looking  
forward to the next quarter century of operation.

Sincerely,

MARPLEX PRODUCTS CO., INC.

  
James L. Sweet  
V-Pres. & Gen. Mgr.

JLS:mah

Rhineland, Wisconsin 54501. (716) 362-3193

Breach Mold & Tool  
New Albany, IN

Brennan Marine  
Bay City, MI

Clover Park Technical School  
Tacoma, WA

Dakota Block Company  
Rapid City, SD

Daytona Country Club  
Dayton, MN

Hass Cabinet Company  
Sellersburg, IN

La Choy Food Products  
Archbold, OH

Lang Manufacturing  
Redmond, WA

Rail's Autobody Repair  
Belle Fourche, SD

Rice County Highway Department  
Fairbault, MN

Robinson Welding  
Livonia, MI

Sauder Woodworking Company  
Archbold, OH

Scott Electric  
Greensburg, PA

Stoddard Aero Service  
Anchorage, AK

Tower Tool Company  
Fraser, MI

White Castle Systems  
Carteret, NJ

William Britland Auto Body, Inc.  
Green Brook, NJ



**CO-RAY-VAC**

Division of

**Roberts-Gordon, Inc.**

Subsidiary of A.J. Industries Inc.  
1250 William Street • P.O. Box 44 • Buffalo, NY 14240  
Phone: (716) 852-4400 • FAX: (716) 852-0854



**RODNEY WILL, INC.**

Manufacturers Representative

2104 NORTHFIELD DRIVE  
LOUISVILLE, KENTUCKY 40222

PHONE 502 425-3551

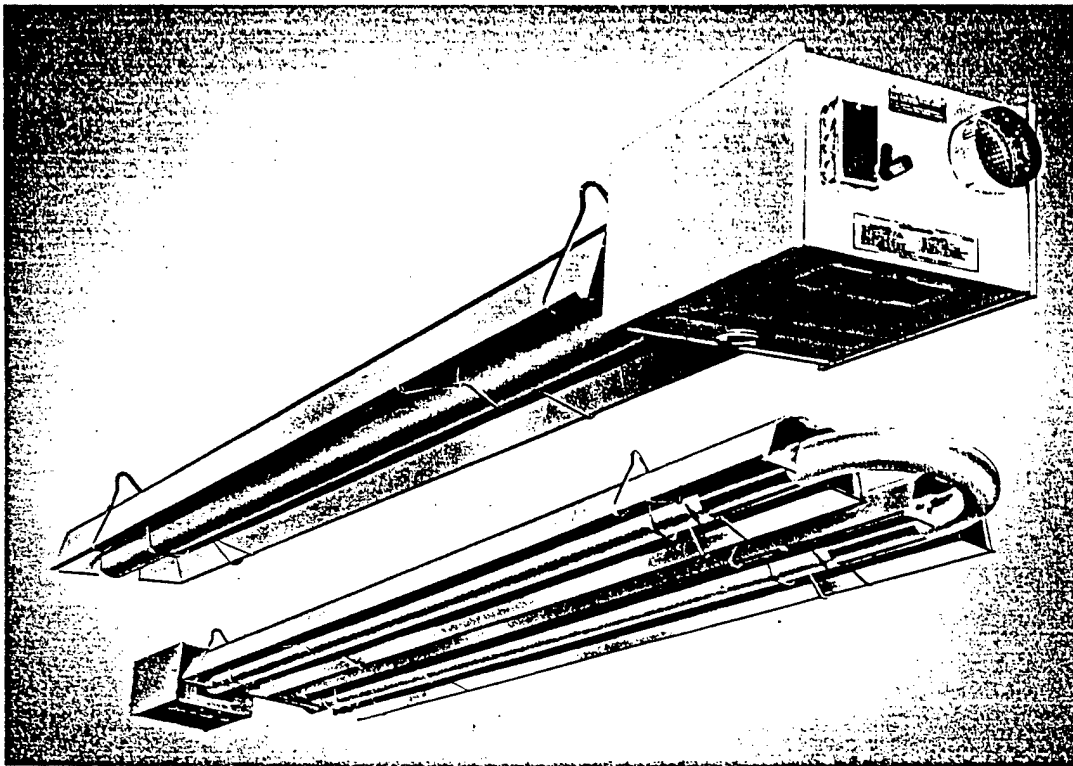
FAX 502 425-3012

CALL TOLL FREE: 1-800-828-7450  
IN NEW YORK STATE: 1-800-221-0955

# VANTAGE II<sup>®</sup>

*Cost-Saving,  
Low-Intensity Infrared  
Unitary Heaters*

RODNEY WILL, INC  
Manufacturers' Representative  
2104 NORTHFIELD DRIVE  
LOUISVILLE, KENTUCKY 40222  
PHONE 502 425-3551  
FAX 502 425-3012



## Roberts-Gordon, Inc.

*Energy Efficient Comfort.*

# VANTAGE II Unitary Heaters

## Lower Fuel Costs and Raise Comfort Levels.

### Demonstrated Savings

Modern gas combustion technology combined with the principles of infrared energy enable VANTAGE II heaters to reduce fuel costs substantially while improving comfort conditions. Users report heating bills cut by up to 50% or more!

### Low Cost...Easy to Install and Maintain

The VANTAGE II models are low-cost, field-assembled infrared heaters that are easy to install and require only minimal maintenance. They are designed to provide years of economical operation and trouble-free service.

### Versatility

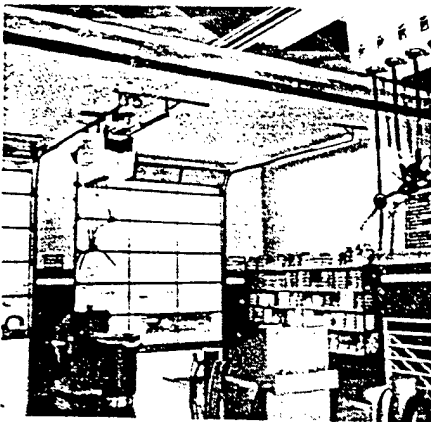
VANTAGE II heaters can be installed separately or in combination to fit any floor plan. Straight, L- and U-tube configurations are available. Tube lengths are offered from 10 through 60 feet. Ideal for large areas as well as hard-to-heat spaces!

### Reliability and Expertise

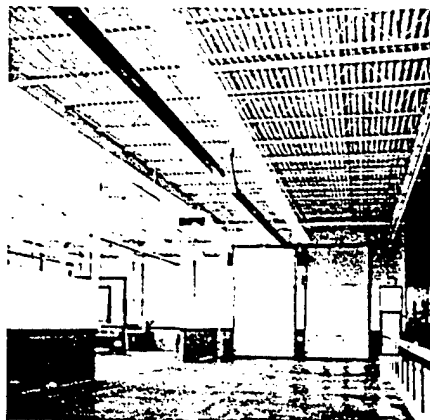
Roberts-Gordon pioneered low-intensity infrared heating systems in 1962 and manufactures the broadest line of low-intensity heating equipment in North America. Backed by a limited three-year warranty, each VANTAGE II unitary heater is built to uphold the well-established Roberts-Gordon standards of engineering excellence, efficiency and reliability.

### Applications Include:

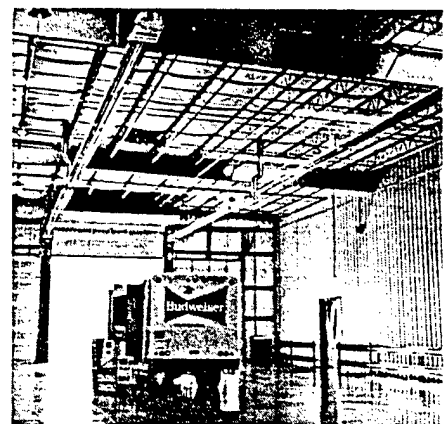
- Automotive Facilities
- Warehouses
- Manufacturing Facilities
- Fire Stations
- Agricultural Buildings
- Recreational Facilities
- Machine Shops
- Aircraft Hangars
- Vehicle Maintenance Buildings



Clean, quiet, draft-free Vantage radiant heat is ideal for automotive service facilities. Unlike forced-air unit heaters, Vantage does not spread dirt, grit or dust.



Vantage unitary heaters are available in a variety of lengths, shapes and configurations to fit any floor plan. Two straight-tube models are shown above in a car dealership.



Floors are kept warm by Vantage infrared energy and act as heat reservoirs to provide rapid heat recovery after bay doors are closed in this warehouse/shipping area.

## Features:

- Extensive use of corrosion-resistant materials.
- Weight-saving construction to ease installation.
- Forced draft design eliminates the need for a heat-siphoning draft hood.
- 10 through 60 foot tube lengths.
- Clean, quiet, draft-free heat.
- Three-year limited warranty on all components.
- A.G.A. design certified.

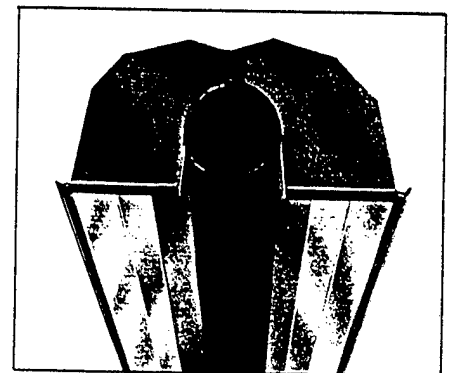
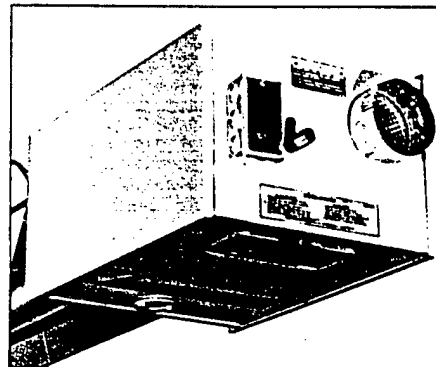
## Burner Box:

- 40,000; 60,000; 80,000; 100,000; 125,000 and 150,000 BTU/Hr. models available.
- Natural gas and L.P. models available.
- Moisture-resistant design.
- Nickel plated steel burner cup.
- Outside air adapter standard.
- Hot surface ignition.
- Three-try ignition module.
- Door interlock safety switch.
- All components easily accessed.
- Electrostatically applied paint.
- Durable spot welded construction.
- Mica flame observation window.
- Balanced air rotor.
- Stainless steel flex gas line and high pressure gas cock included.

## Tube and Reflector:

- 4" diameter 16-gauge tubing.
- Quick assembly couplings.
- Deep-dish aluminum reflectors maximize energy reflection, beaming virtually all of the radiant heat downward.
- Reflectors can be tilted 45° to direct heat where needed.
- Entire U-tube heater also can be tilted 45°.
- End caps included.
- Nickel plated hangers.
- Chrome plated hardware.
- Flue connector included.
- 180° U-package option.
- 90° L-package option.
- Decorative grille option.
- Side reflector option.

"The VANTAGE II heater utilizes design concepts and engineering principles proven by more than 25 years of infrared heating experience."



## Architectural/Engineering Short Form Specifications VANTAGE II CTH2 Series

Gas-fired, vented, infrared heaters shall be furnished and installed in accordance with governing codes and as shown per building drawing(s) as described below.

Heaters shall be VANTAGE II, model number CTH2- \_\_\_\_\_, \_\_\_\_\_ BTU/Hr. as manufactured by Roberts-Gordon, Inc., Buffalo, New York.

Heaters shall be equipped with a direct sense silicon-carbide hot surface ignition control system with 100% shut-off ignition device. Power supplied to each heater shall be 120V, 60Hz, 10. Heater to be equipped with totally enclosed motor with thermal overload motor protection, balanced air rotor, combustion air proving safety pressure switch, nickel plated burner cup, combustion chamber equipped with sight glass for visual inspection of igniter element and burner flame. Air intake collar standard. Radiant tube assembly to be 4" diameter, aluminized steel first 10 feet. Hot rolled steel remainder of unit. (Or at customer option, aluminized steel for entire tube length.) Reflector to be of aluminum material and designed to direct all radiant output below horizontal centerline of radiant tube. Heaters shall be vented in accordance with manufacturer's recommendations as approved by A.G.A. and ANSI Z-223.1 National Fuel Gas Code. Heaters shall be so designed to operate without requiring heater modifications or adjustments on \_\_\_\_\_ gas having a net heating value of \_\_\_\_\_ BTU per cubic foot and a specific gravity of \_\_\_\_\_.

Heaters shall be Design Certified by the American Gas Association (A.G.A.). Supplier shall provide a manufacturer's written warranty covering all components for a period of three (3) years.

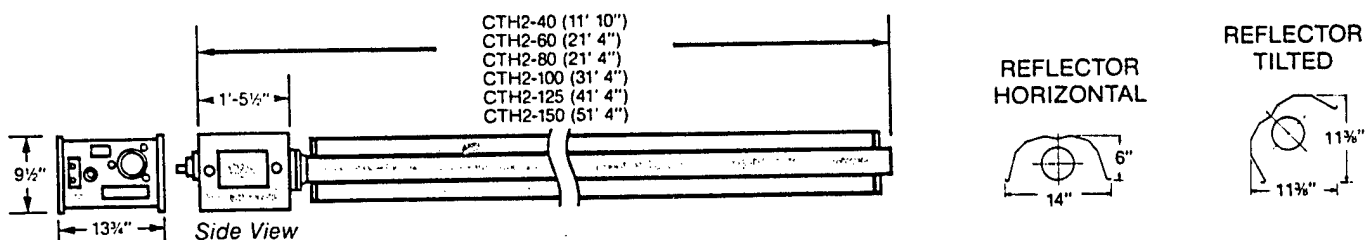


## CTH2 SERIES SPECIFICATIONS

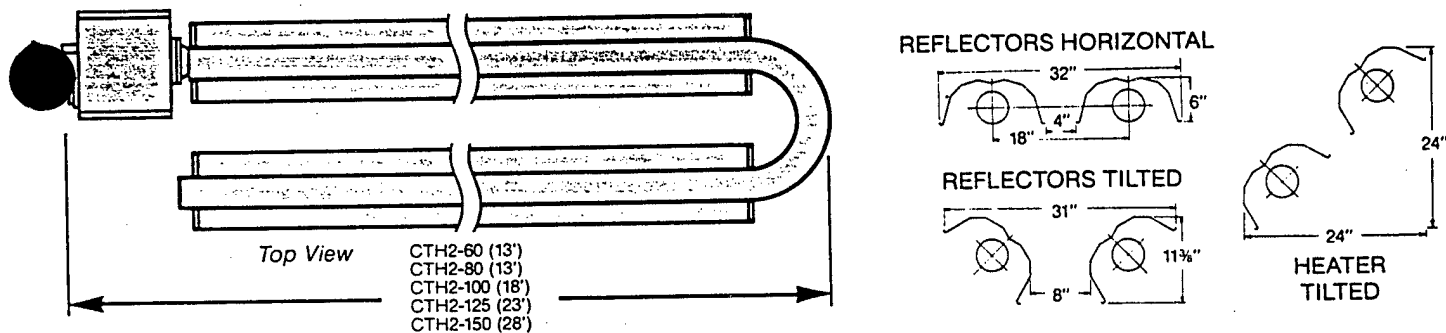
FLUE CONNECTION	GAS CONNECTION	ELECTRICAL RATING	TUBE DIAMETER	IGNITION SYSTEM	MIN. GAS INLET PRES.
4" (O.D.)	1/2" NPT	120VAC, 60Hz. 1.0 amp run 5.0 amp start	4"	Hot surface (Three-try)	Nat. 4.6" W.C. L.P. 11.0" W.C.

MODEL	BTU/Hr. (Natural Gas or L.P.)	SHIPPING WEIGHT	MODEL	BTU/Hr. (Natural Gas or L.P.)	SHIPPING WEIGHT
CTH2-40	40,000	95 lbs.	CTH2-100	100,000	165 lbs.
CTH2-60	60,000	130 lbs.	CTH2-125	125,000	200 lbs.
CTH2-80	80,000	130 lbs.	CTH2-150	150,000	235 lbs.

### DIMENSIONS (Standard Models) STRAIGHT



### U-TUBE



### CLEARANCES TO COMBUSTIBLES\*

Configuration	Reflector	CTH2-40			CTH2-60			CTH2-80			CTH2-100			CTH2-125			CTH2-150		
		Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side
Straight	Horizontal	4"	50"	22"	4"	60"	30"	4"	63"	33"	4"	68"	35"	4"	74"	41"	4"	77"	45"
Straight	Tilted	4"	45"	4"/42"	4"	54"	4"/50"	4"	60"	4"/56"	6"	68"	4"/60"	6"	72"	4"/65"	8"	78"	4"/70"
U-Tube	Horizontal	—	—	—	4"	60"	25"/30"	4"	66"	32"/33"	4"	73"	34"/35"	4"	76"	38"/41"	4"	81"	42"/45"
U-Tube	Tilted	—	—	—	4"	54"	18"/50"	4"	60"	18"/56"	6"	68"	18"/60"	6"	72"	18"/66"	8"	78"	18"/70"

Configuration	Heater	Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side	Top	Below	Side
U-Tube	Tilted	—	—	—	4"	54"	4"/38"	4"	60"	4"/42"	4"	68"	4"/48"	4"	72"	4"/57"	4"	78"	4"/62"

\*See installation manual for complete information.



**Roberts-Gordon, Inc.**

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